INDUSTRIAL ARTS and VOCATIONAL EDUCATION

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Major Problems in Related Instruction

*Homer J. Smith**

THE present discussion concerns that area of vocational preparation variously designated as "Related Subjects," "Auxiliary or Technical Information," "Shop Knowledge," "Topics of Information," or "Problems of the Trade." It refers to any instructional materials not strictly manipulative in character, but which are clearly parts of the training — indispensable requisites to effective trade practice.

Our title suggests difficulties or problems within a clearly defined field and is, therefore, unsuited. In fact, the whole field itself is a problem of the first magnitude. It is a veritable nest of difficulties which we have faced consciously for twenty years and have studied vigorously for ten or five. What is printed following has been written with the hope to heighten interest in this discouraging feature of our work and to encourage attempts to improve our service.

Anyone experienced in vocational education will admit the baffling qualities of related teaching. The failings are not peculiar to any type of training; they are common to preparation for agricultural, homemaking, commercial, and industrial pursuits. It is hoped that the questions and suggestions which follow have pertinency for classes of all types, particularly for trade schools and for the training programs of production and sales organizations. They, doubtless, have equal relevancy to training on the college level for medicine, dentistry, engineering, and other such professions. Each titled section may be considered as covering not a special problem but a single phase of the one big query of how best to impart the knowledges that accompany the skills of any occupation.

Place in the Training Plan

A chief cause of our continuing embarrassment in dealing with the related elements is that we have never accorded this field its rightful place in the scheme of things. We have thought of it and dealt with it as secondary; we have dubbed it "related." Is it not the meat of the matter? Is it not more important in this day than manipulation of tools and machines and materials? Are not employers more dependent upon us for help of this kind? Does not the changing balance or ratio of the employer's need force increasing attention to related instruction? Do the trends not demand its primacy? Do the changes in production practice not point to a place in the sun for the worker who embodies more *whys* and *whens* than *hows?*

Considering their recognized function, the elementary schools do a fair job of imparting information which motivates and vitalizes the skills of the subjects taught. And, they are busily at work on improvement of this phase. The high schools do less well, because of their devotion to making and fixing and their strong desire to impress by the physical product. The colleges, in their turn, excel on technical instruction while often failing to assure that correlation of theory and practice will be near enough in time.

But, we, of vocational education, with full knowledge of the importance of this work, permit many things to interfere with its worthy functioning. Administrative convenience sometimes precludes planning for effective instruction. We equip on the basis of skills. We search for groups needing shop instruction. We grant our manipulative courses the major share of advertising space. We assign our related classes to low-paid, irregular, new, and part-time instructors. We schedule shop courses first in students' programs. We are slow on expenditures for laboratories and classrooms, particularly for the devices which make teaching easier and learning more certain. Where special schools are impracticable because of the cost of shops, we neglect to develop related programs.

Should not every large city have a related-subjects supervisor in the superintendent's official family? He could be made responsible, at least in grades seven to twelve, for coördination of one subject with another, one department with another, school with school, and the system with the work life of the community. Enthusiasm for related content would be developed in the youth as they grow, and their parents would come to view it as a necessity with continual classwork as a privilege. There is no school subject which could not be improved by the aid of such an official, no group of teachers that could not be stimulated to more practical endeavor.

As to the trade schools, we usually select our overhead titles in a way to indicate ideals in division of work. One man is director of the day school; another handles evening classes; and, perhaps, still another the

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part-time students within and without. This may be convenient for purposes of enrollments, fees, records, and the like, although the reason for their separate accounting is not apparent. But, what about teaching content, course organization, methods, and supervision? Are these not the basis for division of oversight? Would it not be appropriate to have a director of shop courses, another of related work, and a third of academic instruction and student activities? Three persons so empowered would come to understand each other and to interlock these fields. Teachers would regard such officials as professional rather than business superiors. Students would profit by reason of improved integration and better teaching. Such a plan would seem to dignify all sections of the offering and permit the related field a deserved emphasis.

Appropriate Subject Matter

The related content comprises facts, principles, and problems from mathematics, physical sciences, drawing, and other such subject fields. There are also the art fundamentals, suggestions on hygiene and safety, the working peculiarities of production materials, and the properties of fuels, lubricants, abrasives, and the like.

Phases of certain academic subjects, when well selected, assume a truly related aspect in connection with some occupations — for example, English in the work of a printer. In the training of draftsmen, some special shop content falls under related classification. In numerous instances a course in one shop field is complementary to training in another, because one set of workmen must often remove and replace what has been constructed or installed by others before them. Thus we see that appropriate subject matter cannot be briefly characterized. It may be almost anything; is, in fact, everything except actual skillful processes.

It is gleaned from experience, from text and reference works, from trade journals and course outlines, from trial and error contact with learning tasks. However, in the presence of such variety of sources and the constant occupational changes with which we are faced, we have come to rely upon analysis for discovery of what should be taught. When we accept the duty of training a person for service of a specified kind, we seek by analysis to find "what he must know and be able to do" in his line of duty as the days and months pass. These things we must teach him.

Some of our leaders analyze an occupation into the jobs which compose it, be they many or few, intricate or simple, brief or of long duration. These jobs are then studied and recorded so that each is pictured in manipulative elements and special knowledges. The records, when complete in detail, show the instructional materials which are used in whole or in part as the training demands may dictate.

These charted analyses become the raw stock out of which courses are made for specific groups. An instructor, preparing a course for a given purpose, refers to the analysis and is guided thereby. He selects the number of appropriate jobs which his class may be expected to master in the time allotted. He chooses both manipulative and informational units and gives them a preferred arrangement. The teaching is by jobs, each matching with all possible closeness, those found in the occupation itself. Under this plan we analyze by jobs and teach by jobs, including related subjects.

Other leaders urge analysis of an occupation into manipulative operations, rather than jobs, and locate knowledge necessary for the operations. It is found that one job commonly involves several of these basic operations and that each new job brings to bear familiar or new operations in everchanging order. The analysis record, under this plan, becomes one of operations and special knowledges rather than of jobs and special knowledges. The subsequent teaching is, consistently, by operations with some job practice in the later stages of the training process.

For purposes of locating teaching content there is little to place one of these plans above the other in preference. Both provide us a record of the skills and informations, and insights that must be possessed by workmen. Two trained analysts, experienced or coöperating with recognized craftsmen, by use of the two methods, would arrive at the same place by different routes. Most teacher-training institutions instruct their students in but one of the methods; most supervisors and trade-school directors ask adherence to the one or the other so that the plans of their teachers may be uniform.

The difference is not so much a matter of ease or clearness of analysis. It is rather a question of what teaching plan is assumed to follow. If there is to be instruction by jobs, analysis had better be by jobs. If there is to be instruction by operations, then analysis by operations. As between the two teaching plans, the writer prefers the second and is, therefore, forced by convenience to favor the second analysis plan as well.

We are all agreed that analysis under some method, perhaps one not yet conceived, is the most productive way of learning what to teach. Had it not been for the emphasis put upon this type of work during the past ten years we would still be unaware of the vast amount and practical usefulness of our related content. We have come a long way in its development; we have gradually increased its allotment of time; we may yet equip our shops as laboratories for the better understanding and the better teaching of "related" things.

Incidental versus Scheduled Teaching

There is insistent claim that the shop processes and their related informations must be taught together as each course proceeds. It is recommended that the knowledges be presented incidentally, even urged that they can in no other way be presented or achieved. We are told that the time and place for related instruction is on the shop floor or at the bench and at the time when problems are met in practice.

These claims and suggestions seem inappropriate and at variance with certain established facts and practical considerations. Theoretically, skills and informations are unlike, call for different types of teaching, and do not mix. One waits upon and impedes the other, if it does not actually confuse and aggravate. Skill acquirement is born of repetition under definite rules and controls. Information acquirement is based upon impressions, comparisons, reflections, generalizations, and judgments. A learner set at drill to perfect a process or at a job with a product in view should be protected from all that will tend to distract or

divert. All his attention is necessary in his task. He must know what to do, how to do it, and then be free to think of improvement or to guard against dallying, spoilage, and injury. There is no time nor inclination to learn the facts and principles involved in the work. This should come before or after.

It is admitted that shop and related courses must be integraded and interdependent. It is acknowledged that there must be close timing of theory and practice. It is true that some processes and projects are impossible unless certain knowledges precede and, conversely, that some informations are unattainable until their need has been actually met in concrete situations. But none of these beliefs argue for mixed presentation.

What instructor, under the stress of production, likes to feel responsible for related teaching in conjunction? What instructor will not, under such a plan, have the work done by those who can do it, thus turning his school into a factory and accepting the rôle of foreman? What instructor can convince that all of his students receive the same related instruction if each learns only what chances to be involved in the jobs that happen to be present at the time?

Related instruction should be planned as carefully and in as great detail as is shop instruction. It should be scheduled in the same way and taught in places and at times apart. If there is such a thing as shop atmosphere and set, we can have faith in related atmosphere and desire. We can equip and plan for this phase of instruction in a way to make it major in the felt needs of most of our students. That some will not improve or appreciate is to be assumed from the beginning.

Scheduled related courses force better selection and organization of materials. They insure better teaching under improved learning conditions. They match the needs of the students most worthy of our efforts and act as selective and guidance agents. This work is too important to remain incidental. It should be separated and departmentalized even though such a plan brings us added problems of grouping, staff, and cost.

Difficult Class Situations

Once departmentalized and scheduled, these courses will offer problems likely to shake us from the change. Students will vary in age, intelligence, aptitude, subject likes, and attitudes. They will appear with differing temperaments, with a wide range of ability to listen and to read, with and without much initiative and independence.

Some groupings will need to be on the basis of general ability, school-grade completion, or subject attainment. Others must be by trades, parts or groups of trades, skill, or experiences.

There will be late or continual entrance tc classes seeming to demand individual methods for all. Texts will be few, ill-matched, or incorrect and library facilities inadequate. Units will be of uneven length and otherwise difficult to administer.

Fields will change, calling for new courses and rendering content obsolete. Calls for training will come which cannot well be met. Instructors will be needed who know their fields but have no other preparedness. Time will be limited.

These and other similar conditions make good related teaching impossible for many and make it a thrilling experience of high consequence for some. Fortunate the director who can find and develop the latter into a staff of special assignment! They will put his school upon its feet and render it justified before a paying public. They will bring about its recognition as a technical institute where time and money are spent on persons and problems of continuing importance.

Effective Teachers

Good teaching always calls first for mastery of field and method, then for sincerity and subject enthusiasm. Effective related teaching demands fitness of special type. There must be ability to analyze occupations, to plan courses, and to select approaches appropriate for differing group needs and backgrounds.

There must be schooling in general far beyond that of the students to be met, so that margins will be apparent and logic unquestioned. There must be acquaintance with vocational processes and equipments and a true sense of relationships. The assisting viewpoint must be got and held.

There must be the tact to deal with colleagues for the sake of course improvement and pupil advancement. There must be willingness to meet special conditions with freedom.

No man or woman is entirely prepared in the beginning to meet these standards. Effective related teachers must be signed and developed. Above all, they must be constantly encouraged, and there is no better means of their stimulation to great effort and adaptability than the paying of administrative deference to their work. The field should be placed on a pedestal. It should be given real entity particularized in special planning and in superior pay.

MAKING BLUE PRINTS
WALKER JUNIOR HIGH SCHOOL, MILWAUKEE, WIS.

Milwaukee Bids the A.V.A. Visitor Welcome

TEACHERS interested in industrial arts and vocational education, who will give themselves the intellectual treat of attending the American Vocational Association convention next December, will find in Milwaukee a rich field for the study of an educational system which does much to foster that which interests A.V.A. members.

Milwaukee has 88 public grade schools, 5 junior high schools, 7 senior high schools, 2 prevocational schools for boys, 2 prevocational schools for girls, a technical high and trade school for boys, a trade school for girls, and a vocational school, all of which bid the visitor welcome and cheerfully invite inspection.

When Chas. F. Perry, assistant superintendent in charge of industrial-arts work, entered the Milwaukee school system over 20 years ago, there were 7 shops operating in grade schools. Today, industrial-arts work is taught to 10,250 pupils in the industrial-arts shops found in 45 of these schools.

A word about the personality of Mr. Perry might not be amiss. Visitors will find in this genial gentleman the idealism which made possible the advances which the school system of Milwaukee has made in the industrial-arts field. His early training and his later education fitted him admirably for the position which he holds. In his youth he indentured himself to learn the machinist trade. After finishing his apprenticeship, he served several years in the capacity of journeyman. Then he went back to the full-time school to get the education which he had not obtained in his youth. After finishing his high-school work, he entered the Worcester Polytechnic Institute and applied himself so assiduously that he finished a 4-year course in 3 years.

Fully intent upon teaching in the industrial-arts field, he accepted a position at Hawaii where he developed the Kamehameha School for Boys. In 1904 he returned to the United States as professor of mechanical engineering at the University of Illinois, and in 1906, upon the invitation of such men as Mr. Sivyer, then prominent in the steel-production field, and Mr. James S. Church, superintendent of the Allis-Chalmers Co., he came to Milwaukee to develop the Milwaukee School of Trades for Boys. This school was later absorbed into the city system and is now known as the Boys' Technical High School.

Mr. Perry's discussion of all of the phases that enter into industrial arts and vocational education in the Milwaukee school system, is not a dry presentation of facts and figures, but rather the glowing picture of an enthusiast who discusses vividly and lovingly that which has been accomplished, not, as he says, by Chas. F. Perry, but by the school administration headed by Mr. Milton C. Potter, and by the teachers of indus-

INDUSTRIAL-ARTS WORK IN THE GRADES
ELM STREET SCHOOL, MILWAUKEE, WISCONSIN. JOSEPH LUKOWITZ, INSTRUCTOR

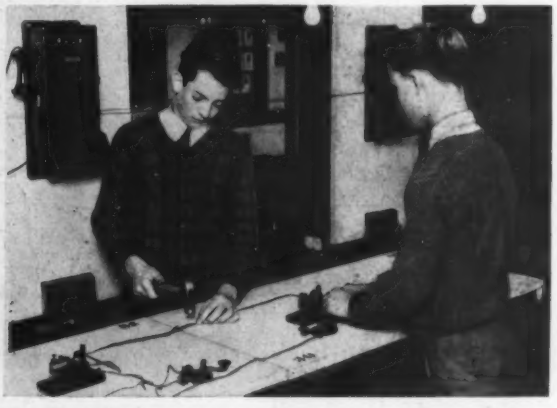
MR. MILTON C. POTTER
Superintendent of Schools,
Milwaukee, Wisconsin

MR. FRANK HARBACH
Secretary, Board of School Directors,
Milwaukee, Wisconsin

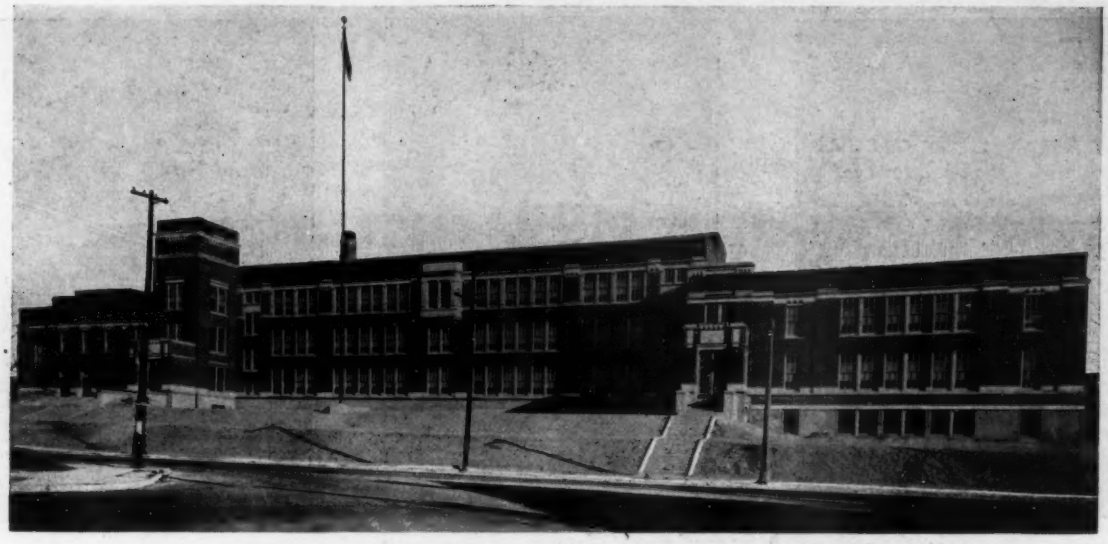
MR. CHAS. F. PERRY
Asst. Superintendent of Industrial Work,
Milwaukee, Wisconsin

WALKER JUNIOR HIGH SCHOOL, MILWAUKEE, WISCONSIN

METAL SHOP, PECKHAM JUNIOR HIGH SCHOOL,
MILWAUKEE, WISCONSIN



JUNIOR-HIGH-SCHOOL STUDENTS IN THE ELECTRICAL
SHOP, MILWAUKEE, WISCONSIN



KOSCIUSKO PREVOCATIONAL SCHOOL, MILWAUKEE, WISCONSIN

trial arts of Milwaukee, who coöperate whole-heartedly in the developmental work which is continually being carried on.

He waxes quite eloquent when he describes the close check-up which his teachers keep on the tools stored on the open tool board in the school shops, so that the replacement for stolen tools is practically nil. No less proud is he of the efficient way with which space is utilized in the school shops which must house up to 40 boys per class.

THE METAL SHOP
KOSCIUSKO PREVOCATIONAL SCHOOL, MILWAUKEE, WISCONSIN

For the child who does not get along in the grade school, Milwaukee has instituted the prevocational school, of which there are 2 for boys and 2 for girls. In these schools the unadjusted boy or girl finds not only sympathy and understanding, but a real effort to help him fit himself into the position for which nature has intended him. Much of the success of this type of school is ascribable to the fine work of Mr. Dougherty who developed the first prevocational school in Milwaukee and who is now principal of the larger of the two prevocational schools for boys in that city.

These two schools are now attended by 1,250 pupils. Their shopwork is divided into 4 industries for the boy who has entered the 7th grade. To this is added home mechanics for those who come from grades lower than the 7th. The shop schedule as it is now developed, assigns the 7B student to woodwork, 7A to metal work, 8B to electricity, 8A to industrial mechanics, 9B and 9A are both elective. The boy who has fin-

HOME MECHANICS
KOSCIUSKO PREVOCATIONAL SCHOOL, MILWAUKEE, WISCONSIN

ished this work can enter the Boys' Technical High School and there get 3 more years, thus equipping him with a wonderful training for his future industrial activities.

MR. B. L. DOUGHERTY
Principal, Kosciusko Prevocational School, Milwaukee, Wisconsin

The 5 junior high schools are attended by upwards of 2,000 boys whose shopwork is divided among three shops, each equipped for two activities. The shop periods are limited to 45 minutes, and the pupil gets five of these periods per week. The 7B group is assigned to woodworking, the 7A to bench metal work, 8B to electricity, 8A to industrial mechanics, 9B to cabinetmaking, and 9A to cement work, and all students take mechanical drawing.

Future junior-high-school shops will be arranged on a different schedule. There will be only two shops, each of which will be equipped for carrying on three different activities. Thus there will be one shop in which the 7B class gets woodworking, the 8A cement work, and the 9B patternmaking and molding, while in the other shop, the 7A group will be given instruction in bench metal work, the 8B in electricity, and the 9A industrial mechanics. Mechanical drawing will be taught in a separate room. All of the shops are equipped for 40 students. Before a boy can work on any of the machinery in the woodworking or metalworking department, he must have advanced as far as the 8th grade.

With the industrial-arts work in the grade school, the prevocational school, and the junior high school so well planned, little need be said of the shopwork in the 7 senior high schools, for in these the shopwork will be found merely a reflection of the high class of organization and development found in the elementary and the intermediate schools. These high-school shops are attended by 2,725 students.

The work carried on at the Boys' Technical High School and at the Vocational School, both of which have made Milwaukee a byword both in this country and abroad, will be discussed in the next issue of this magazine.

Why Industrial Arts in America

*Omar H. Day**

ONE approaches the discussion of such a generalized topic as this with considerable fear and trembling. The ideals of American education were written into the Declaration of Independence by the fathers of the country. They brought forth the ideal of equality of opportunity and this has been and now is the outstanding principle of American education. As this principle has been developed there has gradually grown up among school people an excessive amount of conservatism which has oftentimes retarded the progress of educational practices and thinking, but the original principle of the fathers has not changed. However, we need from time to time to make sharp appraisals of our work to keep us firm in the faith of the fathers and to check our methods of procedure so that the instruction given to our students will lead them toward realization of the dream of equal opportunity.

As you look back over the history of American education, you will find that it has gone by cycles or great sweeps of the pendulum, sweeping frequently from one educational practice to a vitally different one. In the various forms of practical arts education we have done as much pendulum swinging as any other form of education, and, perhaps, we are just now in the middle of such a giant swing. What we do in the next few years will determine which way the pendulum will swing, and it also will determine the amount and quality of support which we will get from our constituency, i. e., from the fathers and mothers of the boys and girls who are attending our classes.

American education is now a part of big business, in fact it is much bigger than most of us realize. In the year 1927–28, over one billion dollars was expended on public education in America, and budgets are increasing at a rapid rate each year. The people of America believe in the principle of universal education and are willing to invest their money and the time of their children in it. The time was when nearly anything could be taught by almost any method in our schools, and it was right "because the teacher said so." That time is gone and we are now confronted with the fact that the American public and the American parent are increasingly interested in and increasingly intelligent about the work of the public schools. Industrial arts is coming in for its share of this intelligent inquiry and if we are to continue to occupy the position in the inner circle of education, we must look to our fences and see to it that our philosophies, methods, and materials are such as to demand the respect of the public. Ours is not the only field of education that has come

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in for this searching inquiry. The searchlight is on all of the subjects in the school curriculum in varying degrees of intensity, so that we need not feel that we are being specially picked out or picked upon.

It is perhaps well, at this time, to give a definite meaning to the various terms to be used in this discussion. By *industrial arts* is meant that school subject of a general character having to do with industrial processes. This is sharply differentiated from the term *vocational training* which has to do with specific occupational preparation.

In order that we may have a background for the present discussion suppose we turn to history, and as we proceed with the historical setting let us watch constantly for the link-up between education and industry.

Early History

In a most interesting book entitled *History of Manual and Industrial Education up to 1870,* Charles A. Bennett gives us some excellent pictures of industrial arts in the olden times. He says, "Savage education consists in learning how to obtain the necessities of life for oneself and family. In his efforts the savage learns the use of such tools as he has and is thus clearly distinguished from the lower animals. Barbarian peoples learned the manual arts through conscious imitation." One of the earliest references we have to specific manual education was in the old Jewish *Talmud,* the book of traditionary law of the Jews. We find from this book that the fundamental motive in Jewish education was religion, but that next to instruction in the Law was instruction in some trade or vocation. It is interesting to note that they used what is today known as the *half-and-half plan,* whereby one half of the day was given to trade training and the other half to a more general form of education. In this book we find this statement: "As it is your duty to teach your son the law, also teach him a trade." So far as we know, the time at which this book was written, is approximately 4000 B.C. We also find that regular apprenticeship existed in Babylonia in 2250 B.C. During the Homeric Age in Greece the arts were considered of great importance and the youth were carefully trained for them, but when we reach the period from 500 to 300 B.C., the manual arts found practically no place in the training of the Greek youth. They were referred to as "banausic" or menial.

Skipping over a considerable period of time we find that in 1693 John Locke in England brought out a book entitled *Some Thoughts Concerning Education,* in which he advanced the idea that education should fit a boy for practical life. He advocated a system of working schools where pauper children should be taught trades in the woolen manufacture.

In 1685 Thomas Budd prepared a plan of education for Pennsylvania and New Jersey which would include teaching each child "that art, mystery, or trade that he or she most delights in." Rousseau, who lived in the eighteenth century, was a great advocate of the principle that "Experience is the best teacher." In his book, *Émile,* he expressed the belief that the manual arts were an excellent means of mental training. Pestalozzi, who followed Rousseau in the last of the eighteenth century, is known as the "Father of manual training." His early efforts were directed to helping train poor children so that they might have a means of earning an honest livelihood. His book, *Leonard and Gertrude,* which purposes to be the story of the establishment of a work school, was a treatise on the correlation of work training and academic training.

I wish to call your attention to the fact that each reference made up to this time shows the closest tie-up between the various forms of industrial education and the work life of the child. Following Pestalozzi we have a long line of men who recognized the worth of manual arts in practical form. These men were, perhaps, led by Fellenberg, who established an academy in which the manual arts were given a prominent place. From Fellenberg's academy came the manual-labor movement in America between 1825 and 1834. The objectives of this movement were not clear and its methods were poor, so its downfall was sure and swift. However, the idea of industrial education still persisted, and we find it coming to life in America in a series of work schools for orphans and delinquents. One of the early schools of this type which has persisted to the present time is Girard College, which was established in 1848. The programs in all of these schools called for work instruction and relatively little was said about the art phase. In the meantime, apprenticeship had come to be a well-established institution. Perhaps the next major development was the industrial revolution in America which came as a result of the invention of machinery which brought forth the principle or multiple production. The Industrial Revolution was the death knell of apprenticeship in its old form, and from that time to this, thinking men everywhere in industry have been seeking something to take the place of apprenticeship. In the early days, schools were looked upon as furnishing the most reasonable substitute, but no one has even up to now brought forth a satisfactory method of doing this task. Technical and shop instruction was introduced into school curricula to provide a general knowledge of tools, materials, and processes of industry, particularly for those who are to direct and superintend the work of others.

The Russian and Sloyd Systems

While these other developments were in process a new note crept into industrial education in America during the last quarter of the nineteenth century. What was known as the Russian system of manual training was introduced. The Russian system taught tool processes. It was based on the belief that a boy should be taught how to use a particular tool and be made to practice on that tool in an entirely abstract manner until he was practically perfect in its use. Then he was taken to another tool and not until he had completed the rounds of the tools was he permitted to begin to make things. Speaking before the International Congress of Education in 1893, E. Kovalevsky, the official Russian delegate to the conference, said, "We consider manual training entirely as an object of general education, but not as one of a special professional character." The Russian system revealed under the test of actual practice a serious difficulty. Work with tools which produced no object of use or beauty, and which was performed merely for the sake of the skill to be acquired, proved to have little attraction for the average American youth.

As a direct rival for the good will of the American educator, the Swedish Sloyd System was introduced about the same time. Gustav Larson, principal of the Sloyd Training School of Boston, said in 1893, "The general aim of Sloyd is the moral, mental, and physical development of the pupil, the mental development being secured by the help of the physical." The Swedish Sloyd System was a rigid series of exercises which the student was required to make. The system was based on these ideas:

1. The exercises should follow in a progressive order from easy to difficult.
2. The exercises should admit of the greatest possible variety.
3. The exercises should result in making a useful article from the beginning.
4. Sloyd seeks to cultivate the aesthetic sense by combining in the models beauty of form, and proportion with utility.
5. Every model should be so constructed that it can be drawn by the pupils themselves and not copied from another.
6. For the regular Sloyd the knife should be the first and fundamental tool.

Quoting again from one of the advocates of the Sloyd system, he says: "As for the content of the work (Sloyd) it should be, on the one hand, neither the systematic study of a trade, nor should it be preoccupation with trifles. The occupations taught should be those ordinarily carried on within or around the home." This does not mean that Sloyd advocated the teaching of a trade, but it does show that home mechanics was considered as a part of school industrial arts long before it was formally recognized as such. The chief obstacle to the success of Sloyd was a decided tendency toward a rigidity of procedure, a pedantic formality based upon the assumption that there were profound psychological and other reasons for the minute observance of the prescriptions of the founders as to the character and sequence of the exercises.

The Craft Stage

From the Sloyd stage of manual training the pendulum swung again to another extreme, that of great freedom. This period was referred to by Vaughn and Mays in *Problems of Industrial Education* as *the craft stage.* During this period all sorts of activities were introduced, such as jewelry, leather work, basketry, raffia, ceramics, and the like. This stage was relatively short-lived and was supplanted by the industrial state which may be said to be the one in which we are now living and working.

You are all more or less familiar with the development in the early part of the present century of vocational training which was brought forward as a substitute for apprenticeship and as a means of giving education of a definite character to the youth who could not take nor benefit by the ordinary high-school and college education. This development received a great impetus by the passage of the Federal Vocational Education Law, commonly known as the Smith-Hughes Law, in 1917. As a result of this development there was great confusion as to the fields to be covered by these two types of education, namely vocational training as recognized by the Federal Vocational Education Law, and industrial arts, as we commonly think of it. For quite a long time and even occasionally today, we find people who refer to these two types of education interchangeably.

As a result of all this, and as a result of the various stages through which industrial arts passed, there exists today much confusion in philosophy, objectives, and methods from which we must extricate ourselves if the industrial arts are to persist as an important factor in American education. This confusion is indicated by the various terms by which the work is designated: Manual arts, manual training, mechanic arts, practical arts, prevocational training, industrial arts, vocational training, and the like. All this indicates the need of some clear and careful thinking.

In the meantime, great sociological changes have taken place. We have passed from an agrarian civilization to an industrial one. Our mode of living has changed from the simple to the exceedingly complex. Our personal demands likewise have changed from few to many. A century ago the larger portions of our population was rural, but today great hordes of people are to be found concentrated in our cities. We have passed from a hand to a machine age, distances have been annihilated. All of this has had a decided effect upon our schools. Only a short time ago four or five years' attendance in the public schools was considered adequate. This was sufficient to produce in the student a reasonable command of the three R's. As you know, the condition now is changed so that very large percentage of our students having completed the work of the elementary schools continue to the secondary schools and an increasing number graduate from high school and enter colleges and universities of the country. The curriculum of the public school has come in for a remarkable change until now we have all sorts and types of subjects as a part of the regular school curriculum.

Present Industrial-Arts Work

What about industrial arts through all of this changing period? It will be worth our while to turn the searchlight of honest inquiry upon ourselves to see what may be found. It seems quite evident that in too many cases our boys in industrial-arts education make some toys or pieces of furniture or other projects of very doubtful worth and questionable beauty, using methods long since discarded, and that is about all the whole business means to them. Instead of training minds to observe, analyze, plan and execute, instead of introducing boys to the industrial world, we are teaching hands to do what are oftentimes unnecessary tasks, tasks which they will largely not do after leaving school.

Further inquiry reveals industrial arts from the very excellent to the very poor, from the very formal, rigid type as advocated in the Russian or Sloyd systems, to the very loose, being conducted largely without rime or reason. We find departments highly organized and others that resemble mob rule. We find expensive, elaborate equipments down to mere makeshifts. We find shops most carefully planned and shops in which apparently the equipment has been tossed into the room and allowed to remain where it fell. We find industrial-arts teachers doing an excellent job of teaching and we find rooms in which no teaching is being done at all.

We find examples where the philosophy underlying the work is clearly thought out and understood, and we find other examples where instead of a philosophy mere mechanical execution exists. We find schools where clearly drawn and carefully thought-out objectives exist, and we find others where apparently the industrial arts are shot at the students much as a scatter load is fired from a shotgun by a hunter who trusts largely to luck that some lone, stray, bullet will find the mark. We find examples from those closely approaching the old Russian type of tool training to all stages of attempted trade preparation. In other words, we do not find in industrial-arts education as it exists today, any one great driving idea, which, right or wrong, will demand the attention of the people. This is no attempt to belittle industrial arts; but we should come down out of the air or come up out of the rut as the case may be, and do some clear, consistent thinking.

The Industrial Arts of the Future

Let us ask ourselves another question — What of industrial arts in the future? There is no doubt that the future of industrial arts in American education lies in the answer to several questions and these answers are to be determined largely by those of us working in the field. If we are to sit back and await developments, industrial arts will surely decline as many say they have already done. Suppose we give consideration to a few of these questions:

1. Shall we be ruled by past practices and present prejudices? Are we going to continue the policy that a procedure is right because it is the way we have always done?

2. Are we willing to subject our work to searching examinations whereby the results of our teaching will be definitely tested in an objective manner?

3. Shall we keep pace with industrial and social development or shall we always be tagging along behind waiting until some thunderbolt comes along to shake us loose?

4. Shall we see, analyze, and know the real values of industrial-arts education and develop them, or shall we continue to insist on using scatter loads, trusting to the Lord and luck that our work will be worth while.

5. Shall we put our work on a plane of dignity alongside of other subjects so that it will demand respect, or shall we continue as has frequently been the case, to apologize for our existence?

6. Shall we prepare ourselves according to standards demanded in the educational world so that other teachers must respect us, or shall we continue to be handy men about the school? We know that it is very common practice for principals and teachers of other subjects to come to your shops and request and often demand that you leave your classroom, quit your instruction and journey to another part of the building in order to make some minor repair or do a bit of construction so that a moving-picture show or some other equally important activity may go forward. Would this same principal take a teacher of English or geometry or any other subject out of his classroom to do this type of work? One of the reasons for this is that our instruction is often so disjointed and poorly organized as not to give an impression of importance to anyone stepping in the room while the class is in session.

7. Shall we make the name "industrial arts" have an industrial meaning or shall we continue to make projects of doubtful value by processes long since obsolete.

8. Shall we accept the challenge of industrial development and make an honest effort to keep pace with it or shall we allow our students to run entirely ahead of us as is now happening in the case of aviation as a new industry. A prominent business man made the very positive statement less than four months ago that the average boy in the industrial-arts shop knew more about the new industry of aviation and knew more about the principles upon which flying machines operate than the average instructor. Ask yourself if this is as it should be.

9. Shall we continue, as has long been the custom, to sit back in smug complacency and wait for industry to come to us for help, or shall we turn to industry eagerly to learn how best to train boys so they may find a niche into which they can fit happily, quickly, and effectively. Ask yourself this question: how long has it been since you, a teacher of industrial arts in the public schools, have been in active touch with industry. How much do you honestly know about the industries of your own community and the opportunities for your students to get into them. Perhaps it is time somebody became vitriolic in an effort to jar loose those of us working in industrial education so that we may make it mean what the title says, rather than to be more or less of a laughingstock for people who are actually engaged in industrial pursuits.

10. Are we going to continue to chase the fetish of the development of a high degree of hand skills or are we going to attempt to develop in boys efficient habits of thinking as well as doing. Anyone who will give the matter serious consideration must realize that the industrial arts possess as many if not more opportunities to teach boys to think than any other subject in the whole gamut of public-school education. Every time a teacher steps into a classroom in industrial arts he has the whole world of industry, commerce, business, transportation, and all the rest to draw from to get opportunities to stimulate real thinking on the part of his students; and all too frequently we go in and insist that the boy spend an hour teaching himself to plane a board so that it is so flat no light can come between the try-square and the board. This is not a suggestion that we eliminate the teaching of skills from industrial arts, but that we shall not make this the one end objective.

Industry is so organized now that boys who are to use their hands only can be trained for the work in a very short time, sometimes as little as ten minutes, in order to hold a job. What industry needs, and what industry is crying for, is the young man who can think as well as do; and it seems certain that unless industrial arts introduces into its work more thought stimulation, we had just as well prepare ourselves to hunt new positions, because, unless it is done, industrial arts is ready to be literally thrown out of the American educational program.

11. Are we going to make an honest search for the answer to the question, "What should my students know and be able to do as a result of my instruction in industrial arts?"

Returning for a few moments to the original topic — "Why Industrial Arts in American Education" — suppose we quote from a few educational leaders in this country.

Dr. Counts, of Columbia University, in his little book, *Secondary Education and Industrialism*, says: "Education must come to terms with industrial civilization and discover its tasks in the new age."

Dr. Edgerton of Wisconsin University in a *Report of Industrial Arts in Our Elementary School System*, says: "If industrial-arts activities are to continue to occupy an important place in the elementary-school program, it is believed by many that they will be expected to share the responsibility of other subjects for helping pupils to develop appreciative insight and reasoning ability in terms of significant interests and actual life needs."

Bonser and Mossman have said, "Industrial arts is the study of the changes made by man in the forms of materials to increase their values and of the problems of life related to these changes."

Snedden and Warner, in a recent book entitled, *Reconstruction of Industrial Arts Courses*, say, "Some laymen still adhere to the faiths preached years ago by Solomon and his followers that vicarious training values of hand and brain derive in large measure from the customary forms of shopwork. Some, too, seem still to retain beliefs that shopwork, such as cabinetmaking, metal turning, or printing, constitutes genuine and important forms of vocational training for substantial numbers of boys.

"But well-informed educators, at least, are keenly aware that the strenuously defended faiths of some decades ago regarding the 'manual training' or the vocational values of the several forms of shop and machine work for boys from 12 to 16 years of age are now no longer tenable."

Looking back over the discussion up to this point we find some significant tendencies in the development of industrial education. Industrial education was born out of the need of men to improve his living conditions, and his first training came in answer to that instinctive need. This idea persisted for centuries even though formal industrial-arts education (though carried on outside of the schoolroom) was only an organized attempt to help man to do for himself that which the savage was forced to do; namely, care for himself and family. All forms of apprentice education presume the very closest relationship between the training program and industrial life. With the introduction of formalized industrial-arts-school education under the Russian and Sloyd systems came a corresponding reduction in the vitality of the work. It lost much of its original purpose of helping man to fulfill his basic needs and took on a pedantic formality and rigidity which made it resemble more closely the academic subjects. By so doing, industrial education received a setback from which it has not yet wholly recovered. As time has gone on, and as an increasing amount of thinking has been done, we find a tendency to attempt to return to the original principle upon which industrial education was founded, namely, that of helping boys and girls, young men and young women to learn of the great world of industry and assisting them in preparation for entrance into it.

In summary, may we say that if industrial arts are to persist as a vital part of American education it is our firm conviction that they will do so insofar as they assist students to prepare themselves to fill those places in life that are best for them and best for society, and to do this, industrial arts must help equip them with adequate information, useful habits of thinking and doing, worthy attitudes, lofty ideals and discriminating appreciations, in citizenship, in industry, in recreation and in all forms of social life.

Correlation for Dull Normals

*Philip F. Roden**

IN the school year 1927–28, the following investigation was made to determine in what ways the academic work of a sixth-grade dull-normal class could be motivated through correlation with shopwork. To do this, an important change was made in the diversified shop program of the sixth-grade pupils in one of the city schools, so that during each term of this year the lowest division of 6A was given shopwork for two whole afternoons per week, while the lowest division of 6B was given three afternoons per week, instead of the usual 90 minutes per week allotted to each class. It was hoped that these boys, who were of the dull-normal type, would become more interested in their academic work if it were correlated with the shopwork in such a way as to make the former seem more purposeful. The girls of the aforementioned classes were given the same program in domestic science.

The academic teacher came to the shop with her class, for one afternoon each week, in order to find out what the boys were doing. During this time, she helped the shop teacher in checking over the boy's work, and also discussed with him ways and means of tying up the shopwork with the academic work. It was decided not to force correlation where it did not exist, but to let each type of work go smoothly along its own course, linking the two courses together only when they seemed to parallel each other. The project method of teaching was to be used wherever possible.

One of the most remarkable results of this experiment was the fact that not one boy quit school from the sixth grade of this school during the year.

Since a full account of the year's work in correlation would be too lengthy for an article of this kind, this discussion will be limited to a study of the results obtained with one class during the working out of the experiment for one term only. The summary of the two terms' work with each of the two classes, however, and certain conclusions drawn from an analysis of the work of the four classes subjected to this experiment and investigation also are given.

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Results With Group 6A-3

(Spring Term)

Week of February 20

Geography — Study of the British Isles. These isles furnish tin which we use in making tin cans in this country. Tin cans are cut up in the shop to make parts of your toy airplanes.

Spelling — Words connected with the making of the toy airplane: periscope; monoplane; biplane; miter box; gimlet; auger; vice; vise.

Reading — Look up *vice* and *vise* in the dictionary. Which is the word applied to the holding on your bench?

Week of March 2

Arithmetic — Finding what part one number is of another. Use examples taken from dimensions on the toy airplane.

Language — Description of how to get a can of paint ready for use, including what not to do.

Writing — Practice on letter *s*. Use statement, "A working edge must be smooth, straight, and square."

Spelling — Gilt; aluminum; tail skid; bread; motor; exhaust; center punch.

History — What kind of saws do you think the colonists used?

Supplementary Reading — Look up the above in *The Saw in History*.

Geography — Several boys wanted to make a panorama machine for the classroom teacher that they might make up reels about life in the countries they were studying in geography. One boy was assigned to that job.

Morals and Manners — Cleanliness. Every boy who has to cut up wood in the court outside the shop door should clean up the sawdust and not leave it for the janitor. Should a boy throw a piece of wood across the room at the scrap box?

Health — Why should the boy using the soldering furnace be sure it is completely turned off when he is through?

Week of March 9

Arithmetic — One of the boys made a match box and wanted to know how much he would pay for it. The class agreed to help him figure the cost, so they were given the following problem involving areas and decimals: Milton made his match box from a piece of galvanized iron 9½ by 8 in. The galvanized iron cost $0.0003 per square inch. How much will he have to pay for it?

Geography — The boys were asked if they would like to build a model volcano a few inches high and with real smoke coming out of the top, so they could use it in their study of the mountains of Europe and also exhibit it in the different classrooms. Upon their enthusiastic response a contest was arranged. They all agreed to study hard on that phase of their geography work and at the end of the month let their teacher decide which boy knew the most about the mountains of Europe. That boy would be appointed to make the volcano.

Language — Two-minute speeches telling what a volcano is.

Week of March 22

Arithmetic — Drill in division of mixed numbers. The boys were given two problems with which they had difficulty in the shop (*a*) We have a board 8⅜ in. wide which we must cut in two. At what distance will we set the marking gauge to draw a line down the middle? (*b*) What is the measurement to draw a line down the middle of your boat to lay out the keel? The boat is 3⅝ in. wide.

Geography and Drawing — Some coping-saw work was planned for late in the term. The boys agreed to hunt for pictures of the animals of Europe and in the drawing period trace them out and make templates of them. These templates would be used in cutting the animals from thin wood in the shop later in the term. The finished product would go into the school museum.

Language — Compare the wild animals of Europe with those of the United States.

History — One boy saw a job sheet of a fire-building set and wanted to make one. The class was studying colonial life at the time so he agreed to make an extra one for his class museum to be used in illustrating one phase of Indian life.

Supplementary Reading — Outside reading on volcanoes; books, newspapers, etc.

Civics — Public library. If you cannot get pictures for manual training and geography elsewhere, how would you go about getting them in the library?

Spelling — Words connected with the sailboat the class is making in the shop; sail; keel; rudder; mast; staple; smooth; varnish.

Week of April 2

Arithmetic — (*a*) Finding the area of triangles with the sails of the boat as models. (*b*) The shop teacher was making a small galvanized-iron tank and the boys fell to guessing how much it would cost. Noting this, the teacher asked the boys to give him their guesses and then figure the cost in the arithmetic period to see who was the closest guesser. The tank was made from a piece of metal 32 by 12 in. The cost was $0.0003 per square inch.

Geography — Continuation of work on volcanoes.

Language — Correction of compositions on volcanoes and discussion of points omitted.

Spelling — Words connected with sewing sails on toy boat: muslin; thread; needle; scissors; hem; cloth; strap iron; knot; cleat.

History — Name three great historical voyages made by sailing vessels. When and where were they made?

Drawing — Continuation of work on animals.

Week of April 20

Arithmetic — Changing fractions to decimals. The following examples were used. (*a*) The chamfer on the middle piece of your tie rack is ⅜ in. Express this in decimals. (*b*) The chamfer on the bottom is ¼ in. What is the decimal equivalent of this? (*c*) The holes bored in the crosspiece are 9/64 in. in diameter and those on the bottom are 7/32 in. Express these dimensions in decimals.

Reading — The boys wanted to know how they were going to finish their tie racks. Upon being shown the water stain, they called it by several different names, so they were assigned to look up stain, shellac, and varnish in *Trade Foundations*.

Language — Discussion of above.

Spelling — Stain; shellac; varnish; diagonal; chamfer.

Week of April 27

Arithmetic — One boy made a flower-pot stand and wanted to know what he should pay for it. He used a piece of wood 10 in. square, costing 12c per square foot. The screw eye that went with it cost 1c. The class figured this out as part of their arithmetic.

Language — One of the boys had been out of school for two months due to sickness. The other boys each brought in a penny to pay for a sailboat to send him and then wrote letters in class to him telling of their work in the shop and hoping that he would enjoy the boat while recuperating in the country.

Spelling — Words connected with the marble game the boys were just starting to make: Marble; curve; metal; hammer; bench hook.

Civics — What provision is made for manual training in the school system?

Week of May 4

Arithmetic — Review of areas and decimals through figuring cost of the marble board: The wooden part of the marble board is 25 by 4 in.; price 12c per square foot. The metal border is 2 by 51 in.; price $0.0003 per square inch. Nails

cost 1c and the bottom cost 1c. What will you pay for the marble board?

Geography — } Continuation of work on animals of Europe.
Language — }
Drawing — }

Week of May 18

Arithmetic — Area of rectangles. A brush being made in the shop is 3 by 18 in. There are four holes per square inch to put hair in. How many such holes are there in the brush?

Language — Describe how you are making your floor brush in the shop and give an account of the chief difficulties.

Supplementary Reading — Read account of brushmaking in *Trade Foundations*.

Hygiene — What is anthrax and how may it be contracted?

Spelling — Words used in connection with brushmaking: brush; brooms; bristle; handle; hair; wire; pliers; snips; scissors; dollar.

Drawing — Drawing of boat made in the shop.

Civics — How can I use this brush to keep my share of the city around my home looking better?

Week of May 25

Arithmetic — Work in fractions through use of auger bit.

Language — The boys were gluing the hair in their brushes. When asked, many of them thought glue, like rubber, came from a tree. They wanted to know more about glue so it was arranged for them to write to a prominent glue company to get literature on the subject.

Supplementary Reading — Look up and read about glue in the shop books you have in your classroom.

Spelling — Glue; bolt; thread; maple; price.

Geography — What is there in your study of Brazil that might suggest that a great deal of glue might be manufactured there? (Brazil is, in some sections, a cattle raising country.)

History — One of you will make a toy llama when we do our coping-saw work. Do you know that the llama is one of the two or three beasts that have been domesticated since prehistoric times?

SUMMARY

Number of Units of Correlated Work for Each Class

	Fall Term, 1927		*Spring Term, 1928*	
	6A-4	6B-3	6A-3	6B-4
Arithmetic	7	5	9	5
Geography	3	1	5	3
Language	9	9	8	5
Physiology (Health Hygiene)	3		2	2
Reading	3	1	6	4
Spelling (No. of Words)	40	10	60	44
Morals and Manners	6		1	
Writing			1	
Music	1			
Drawing	1	2	2	1
History		1	4	3
Civics	3		3	

In studying these figures, several things must be borne in mind. (*a*) The records of the 6B-3 class of 1927 are not complete. (*b*) Certain of the units of work were stretched out over several weeks. (*c*) An attempt to correlate work was not made every week.

Comments and Conclusions

1. It may seem to the casual observer that very little correlation was done in a term's work. The explanation for this is as follows:

a) The children worked with were of the very dullest type, and consequently needed a great deal of time in the teaching of most of the items of their regular classroom work. This time was cut down from two to three whole afternoons each week when the boys were in the shop. Certain items of classroom work had to be carried through in order to satisfy the requirements of the classroom syllabus. This did not leave time to introduce as much correlated work as otherwise might have been done.

b) The classroom teachers were also effecting a certain amount of correlation with the girls of the class in regard to their sewing and cooking lessons, and were consequently pressed for time in teaching all that they had to teach.

c) This account of the work was written during the third week of May, more than one month before the close of the term, and so does not include a whole term's work.

2. It was found, in this particular study, that nearly every week the arithmetic, language, and spelling being done in the classroom could be motivated and made more purposeful through correlation with what the boys were doing in the shop at the time. Drawing could be worked in only occasionally, due to the requirements of the course of study in drawing and the time available. Supplementary reading could be worked in whenever the boys struck a problem which required that means for its solution. Geography and history could be correlated only when those subjects seemed to be running parallel to that of the shopwork. Morals and manners, physiology and civics, were given very little time in the classroom owing to the fact that the boys were in the shop so much of the time. For this reason, these subjects were not correlated as much as they might have been under different conditions. The remaining subjects, writing and music, were correlated in but one lesson a piece during the whole year, as the subject matter and method of teaching did not seem to admit of correlation with shopwork in this particular setup.

3. No attempt was made to get objective evidence of the boys' interest in this type of work. However, it is interesting to note that when questioned after having this work for several months, they all said (and seemed to be sincere in so saying) that when studying areas and decimals and other work in arithmetic they would rather use the problems tied up with the shopwork than those in the arithmetic books because then they could see the need for doing the problem and for knowing how to do it. The same principle held true, they said, for the correlated work in the other subjects.

CHARACTER AND INVENTIONS

Scientific discoveries and inventions cannot safely go much further until the character of our young people is developed to use properly these uncovered powers and facilities. — *Babson.*

TEACHING THE BOY

There is need of a wider vision. There is too much of a tendency to teach shop for shop's sake and not enough for boy's sake. The great purpose of industrial arts is to teach certain important and significant elements in civilization. — *Lewis Gustafson.*

Establishing the General Shop—IV[1]

*William E. Warner**

Nature and Range of General-Shop Experiences

The word "experiences" is purposely used here. The use of prearranged job, instruction, assignment, information, and other well-digested instruction sheets is somewhat deadening to a young adolescent boy who is still in the formative period and not nearly ready for things peculiar to the training of an artisan. As far back as 1908, Bonser pointed out that "the pupil of the upper grades is characterized by a loss in accuracy of movement from 12 to 14; by a fluctuation or decrease in muscular strength at 14; by a number and complexity of physical changes giving rise to a wide range of new emotions, interests, and tendencies; by the awakening of powers and capacities up to this time almost dormant; by the development of scientific curiosity and inquiry; by a great tendency to hero worship and emulation; by a development of social consciousness and social responsibility; by a tendency to try all sorts of vocational activities and as quickly abandon them for something else in a kind of unconscious endeavor to find oneself; by the development of leadership and loyalty in following leaders; and by numerous minor similar developments. . . . Summarized, it may be said to be a period of very marked physical change and growth; and of even more marked change, growth restlessness, and uncertainty in mental life. *It is a period when any attempt to permanently direct and determine one's life activities is accompanied by dangers of arresting development, and destroying or perverting desirable impulses, interests, and capacities!*"*

These experiences will be of a broad and varied sort and will not be limited at all to the confines of the four walls of the general shop. If experiences may be thought of as outcomes of well-directed activities, then the following examples will be suggestive of the different methods of teaching which may be employed in a well-conceived general-shop situation: planning; random or planned exploration; manipulation of tools, machines, and materials; purposeful reading; round-table discussion; play and recreation; making judgments, and other activities resulting in *experiences* that make for *developmental* growth. In passing, it should be noted that "manipulative" activities constitute but one of the broad range of experiences found possible in modern industrial-arts teaching, particularly as it is seen in the general shop.

With such a preliminary statement of the nature of general-shop experiences, it is possible to interpret their range and to make a list that will not only prove feasible but suggestive to teachers in the various types of schools mentioned in Part I of this discussion. If the objectives also enumerated in Part I, are to be achieved in any degree, then it may be considered wise to divide any listing of general-shop experiences into two groups: *basic* experiences and *supplementary* or *suggestive* experiences.

Even with the rapid development of the general-shop idea in America, there is still very little scientifically determined knowledge of the subject-matter applications which should be made from day to day. Anyone attempting a list of jobs or even *experiences* without making a preliminary research, does so at the risk of branding himself a tyro. The following lists, therefore, are offered in suggestive fashion with a full realization of their incompleteness.

1. *Automotives.* From an investigation and exploration standpoint all of the *parts* and *functions* of a wide range of automobiles may be *identified* and *discussed.* These would include such important items as: cylinder head; motor block; crankcase; oil pan; fan and belt; intake and exhaust manifolds; spark plugs; electric wires; pistons; generator; starter; distributor; coil; bearings; timing gears and chains; air pump; oil lines; valves and tappets; water pump; radiator; hose connections and drain cock; motor supports; marks on flywheel; clutch unit; transmission unit; universal joint; drive shaft; differential gears; axle shafts and bearings; mechanical, hydraulic,

[1]Conclusion. Artices I, II, and III appeared in the August, September, and October issues of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION.

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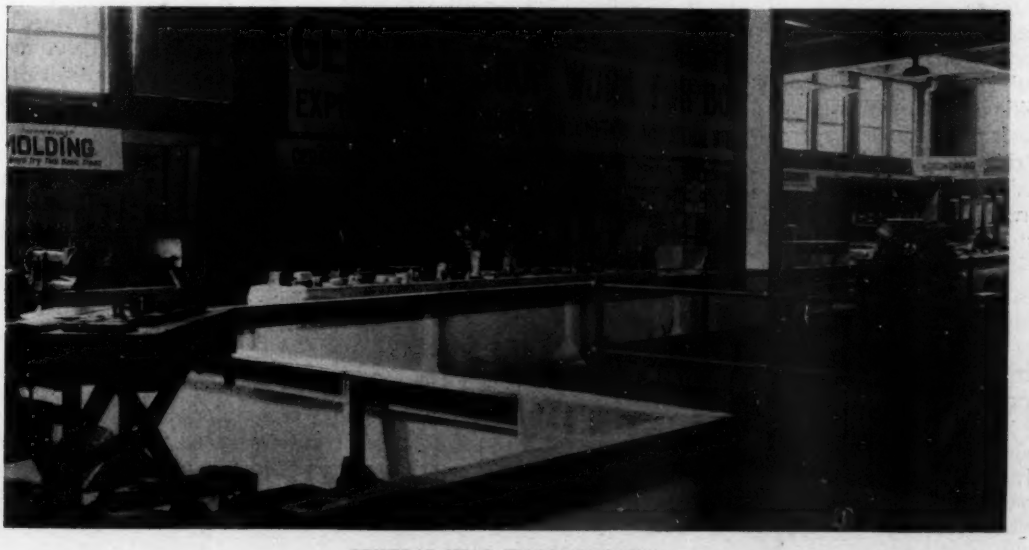
*Italics by the author.



GENERAL-SHOP WORK DISPLAY

THE CERAMICS DISPLAY

or air brakes, both internal and external; box or taper-type chasses, and cross members; semi, full elliptic, platform, and cross springs; lubricating systems; artillery, disk, wire, and cast-steel wheels; high-pressure, semi- and full-balloon, cushion, and solid tires; semi- and nonskid treads; choke, throttle, accelerator, starter and horn buttons; windshield-wiper adjustment; light switch; fluid or electric gasoline gauge; ammeter and speedometer; clutch and brake pedals; stoplight switch; dimmer button; gear shift and emergency brake levers; repair tools; gas- and vacuum-tank lines and petcocks; bumpers and brackets; friction, spring, oil and air shock absorbers; fenders; battery; muffler; all-steel, wood-and-steel, and wood-and-aluminum bodies; adjustable and stationary seats; cotton, linen, mohair, friese, velour, broadcloth, leather and pantesote upholstery; plate, nonbreakable, and nonglare glass.

Other experiences might be suggested through taking down and reassembling and operating, an automobile. Further problems suggest themselves in chassis lubrication; tire repair; care of body finish and doing body refinishing; discovery and elimination of squeaks and rattles; trouble shooting; adjustments, and simple replacements; visit to automobile or airplane factory, as well as to a garage repair shop; study of automobile costs, discounts, and methods of selling; and inquiry in the nature and range of occupations peculiar to the automobile and airplane.

2. *Ceramics.* These experiences will aim at an understanding of the potter's craft and the various aspects of the range of ceramic industries to be found throughout the United States. Projects may include hand-built pieces, forms shaped by a template, one-piece mold casting and more complicated forms, experiences on the potter's wheel, firing, glazing, and excursions to the various ceramic industries that may be locally available. Supplementary studies of ancient pottery and modern pottery including the use of clay products in all forms of manufactured articles are suggested.

3. *Concrete.* In addition to a study of cement manufacturing, a broad range of useful projects like the following may be adopted in the general shop. Repairing and patching concrete walks, walls, and floors; study mixtures and combinations of aggregates in such projects as: walks, walls, pavements, urns, jardinieres, book ends, posts, and decorative projects; learn through practice and from investigations, the use and meaning of troweling, brushing, tooling, tamping, curing, setting, reënforcing, wet mix, dry mix, floating, and coloring. Youngsters interested in contracting as a vocation might do well to carry on further investigations involving calculating, estimating, reënforcement, stucco, mortar, steel forms, and the like.

4. *Drawing and Design.* As no conceivable unit of the general shop is devoid of design and drawing problems, it may be readily understood why such a unit should be included in the layout. Daily contacts with this unit are unavoidable. The use of drawing and design is found to be useful to youngsters: First, in making a pictorial representation of projects to be made; second, sketching the results of investigations regarding work underway; and third, completing reports involving graphic representation giving the results of experiences gained in the general shop. It should be noted in passing that this unit will affect the use of nearly all materials found in the general shop as: Wood, plaster paris, paper, clay, wax, iron, brass, concrete, leather, paint, glass, ivorene, tin, fabrics, wire, Celotex, and the like. Ideas for further experiences might be found in a boy's life outside of school, at play, in games, in hobbies, at home — both in his room and concerning problems peculiar to his home as a whole.

5. *Electricity.* Experiences in this unit may conceivably extend into any phase of electricity found in present-day life. Lighting problems concern not only the home, but theaters, stores, streets, shops, industries, motion-picture photography, aviation, automobiles, playgrounds, etc. Simple installations and repairs may be made in addition to a wide range of investigations. Other suggestions include: study of electrical hazards, safety devices, methods of accident prevention; methods of giving first aid to persons

suffering from electrical shock; learning the use of the telegraph, telephone, and radio; making a trip to an electrical manufacturing industry; making models of things electrical; and carrying on experiments concerning any practical phase of this giant industry of modern life.

6. *General metals.* This term refers to experiences found in forging, welding, brazing, and heat treatment, engine-lathe work, drilling, tool grinding, and more advanced machine problems. Suggestive experiences for junior-high-school boys would include: sharpening a knife, shears, and scissors; cleaning, lubricating, and making adjustments on some piece of mechanism such as a: bicycle, lawn mower, lock, automobile, lathe, drilling machine, vacuum cleaner, washing machine, victrola, and any other machine within the capacity of the shop and the interests of the boy; the making of such things as a screw driver, cold chisel, punch, hammer, knife, paper weight, spring, and a wide range of articles with strap iron. Broader experiences would require trips to industries where various phases of employment in general metal work could be studied at first hand. Supplementary experiences might include actual employment in a metal industry during the vacation period, building a model engine and other things of interest which may attract the boy to a career in some phase of the metal industries.

7. *Molding.* Boys should have an opportunity to cast at least one pattern of their own making in metal. Things may be cast in any metal from type metal to brass. Wages, hours, foundry, practices, kind of people employed, and studying things cast in metal may be developed at length. Among other things, the castings of a "wasp" airplane engine is of extraordinary interest to boys at present. There is even romance to be found in reviewing the history of foundry work in brass, bronze, iron, steel, and other metals. Simple projects like medallions of great men, book ends, and simple problems involving cores may be taken up.

8. *Printing.* Perhaps no other unit is exploited more badly than the printing unit when care is not taken to keep the experiences educationally beneficial. Jobs involving various phases of the printing trade may be included if they teach a wide appreciation for printing. Suggestive projects may include the making of paper; designing and cutting a wood or linoleum block; study of covering, title-page and other layouts; and practices and executions in writing and printing ones own compositions. Extended study of linotype and monotype work, photo engraving, lithography, offset presswork, steel and copperplate engraving, type founding, job and production printing, including publishing experiences, may be made a part of the course. A certain amount of printing work needed by the school should be done if this is matched with an equal amount of work instigated by the boy for his own benefit.

10. *General Woodworking.* Experiences in this unit may be grouped under the head of junior carpentry, hobbies involving woodworking, cabinetmaking, patternmaking, investigations into fields involving woodworking, finishing, patching and polishing, forms for concrete work and simple household-repair jobs. Specific experiences in these various types of general woodworking include activities resulting in the earning of Boy Scout merit badges; construction of sleds, skiis, screen doors, bins, ladders, sheds, a cabin in the woods, a fly catcher, athletic benches, a ticket booth, playground equipment, rabbit trap, radio masts, a study of upholstering materials, the identification of trees and woods, excursions to a furniture store, and to an interior decorating house, refinishing antiques, making real ships, ship models, outboard motor boats or other boats, making patterns to be molded in sand, and other experiences limited only by time, money, season, patience, and the ability of the instructor, as well as of the boy, all judged by the seeming value of the project.

11. *All Units.* Experiences involving two or more units are to be desired. The making of a modern lamp would involve electricity, woodwork, design, drawing, glasswork, finishing, and its placement in a room. J. I. Sowers, of Miami, Florida, is very well pleased with work in his school in boat building which invariably draws in almost any trade one can mention including such things as: ship carpentry, wood and metal finishing, glazing, machine shop, design, paper hanging, sanitation, electricity, planning, ventilation, mechanics, knowledge of navigation, and so on without end. Experimental projects carried on by more-advanced boys will ordinarily include several units of the general shop.

Dangers in Too Rapid Development

Board members and school officials must learn that *it takes a long while* to develop and teach a good piece of general-shop work. Too frequently, these people as well as shop teachers, are unable to comprehend the significance of the general shop. Occasionally a general shop is conceived and developed overnight by means of expedient measures, whereas it will take years of scientific study to shed much light on such knotty problems as those suggested by: objectives, methods, learning, organization, testing, instructional material, supervision, teaching load, curriculum relationships, and so on until the idea of the general shop is satisfactory to all.

Many general shops are equipped too rapidly, or are inadequately equipped to permit the type of program necessary for successful teaching. Teachers who have taught one-industry shops for a period of time, find it most difficult to adapt themselves to a general-shop setting and are almost helpless with the changing views concerning the possibilities of such work. A single general-shop problem accompanied with suitable equipment is enough to stump any good shop teacher of the manual-arts type. The preparation of instructional material in a comprehensive general shop will take from two to five years, even when instructors have learned how to do this interesting and complicated phase of shop teaching. The enrollment in a new general shop should be kept relatively small until the developments may be made that are peculiar to the general-shop situation. Facts of operation cost must be learned, and a teacher must find out for himself how to help boys in many types of industrial work, all going on at the same time. No general shop can be run without an effective personnel organization of pupils enrolled in the class. This is upsetting to teachers who have been accustomed to making group demonstrations and dictating all things going on in the shop. Too rapid development also tends to blind everyone concerned with a situation, because they will likely

have been too well steeped in more traditional work to keep an open mind regarding the ultimate development of a general-shop program. One of the most serious dangers of rapid development is seen on almost every hand in the confusion of tools, equipment, supplies and irrelevant motions on the part of pupils who find themselves at sea in a muddle of disorganization.

Sound procedure would seem to require a five- or ten-year program for developing a good general shop. One must remain open-minded and study the problem from every angle. Lighter teaching loads are important, and careful contemplation of the problems back of establishing a general shop should be considered. Wide contacts with teachers of general shops in other schools and cities are important and closer contact with industries should be made. Boy interests, as well as extensive follow-up studies to judge the final development of these interests will take some time. Countless other problems occur on every hand. These will make it necessary for all proponents and general-shop participants to make continuous study of this problem if successful shops are to be established.

Professional Sources

No extensive bibliography of the technical literature for use by the teacher and pupil is yet available. Such a bibliography should include references to all phases of industrial life, and be much more extensive than an inclusion of references on the units usually found in a general-shop setting.

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Frills and Try-Square

Make-Believe Materials

"Is that your new house going up on the corner of Thirteenth and Park Avenue, Mr. Try-Square?" asked Frills as he marked a drawing with a big P for poor.

"Yes, that is where my house is supposed to be going up," grumbled Try-Square, "but the contractor told me this morning that he had run out of cement blocks for the basement and could not get more for a week, so I guess we will live in a tent this winter and have our house-warming next spring."

"Cement blocks!" drawled Frills, "Well, I would never wait for cement blocks if I were building a house. Why not use the cement in the way of cement and run it into a mold that would make your walls all of a piece, Mr. Try-Square?"

"Oh, we had our minds set on a stone house, Mr. Frills, but when the figures came in we found that stone would cost more than we could afford. The artificial stone man gave us a good price on his make-believe stone and guaranteed it to look more regular and even than real stone, so we specified that. 'More like stone than stone itself,' he put it, 'and more durable,' but I hardly believe that, for some of it looks a little bit sandy to me. Sand is cheaper than cement, you know. But I suppose from what you say, that you don't like make-believe stone, Mr. Frills?"

"No, I don't want any make-believe in that new house of mine," mused Frills. "I don't want any tin shingles or tin bricks or linoleum tile or painted marble or imitation wood or stone or anything that does not show for what it is. The great trouble with my house, Mr. Try-square, is that it is also make-believe so far. We can't afford to build the house we want, so we are living with our ideals in a flat, which though quite convenient is not at all ideal."

"Mr. Frills, you remind me of the farmer about whom I heard the other day. When approached on the question of buying an auto, he emphatically said that he was not in a position to buy the car he wanted, but that under no consideration would he ever buy such a make-believe car as a Ford. Time passed. All of his friends and neighbors were driving their Fords hither and yon, getting a great deal of enjoyment and real service out of their cars, while he still drove his slow team, adhering strictly to the resolution which he had formed years before. His sons, in the meantime, had grown up and one day the oldest of them took courage and bought a secondhand Ford. The father, of course, was quite upset that a Ford should be brought on his premises and naturally would have nothing to do with it at all. But one day a long-distance telephone call apprised the farmer of the fact that his brother was seriously injured in an accident and that he would have to come at once to the city 20 miles away, if he wanted to see his brother alive. There was no available train service and to make that distance with a horse and buggy was out of question, as it would consume too much time. Under the conditions therefore, he accepted his son's invitation to be taken to the city in the Ford, arriving there in about 40 minutes. This incident brought home to him that even if the Ford might not be an ideal car, yet that he could have saved lots of time, and enjoyed many pleasant rides if he had bought one years ago instead of waiting for his chosen car which he might never be able to afford."

INDUSTRIAL ARTS and VOCATIONAL EDUCATION

J. J. Metz, Editor

THE SHOP TEACHER'S JOB

In the September, 1930, issue of *The Vocational Reflector*, published at Carson City, Nevada, the following very important hints are given to trade teachers:

"From the standpoint of a successful trade teacher there are four points that should be considered:

"1. The most important step is to determine the objectives which he expects the student to attain. Without some definite objective in mind, teaching would be like sailing a ship on the ocean without a chart or destination toward which to travel. In planning the objective the level of the student should be considered — his past experience or his prerequisites and his aptitude.

"2. He must be able to analyze a job and block it out into suitable teaching units, these units to be arranged in the proper sequence, leading up to the finished product. If the job is of much length, checking levels should be established at suitable points.

"3. He should study the learning ability of the student and plan a method of instruction to fit the particular case. The student should be taught how to think. Of course methods of learning to do a job the best is by repetitive practice in doing it. Until a student is able to do a job unaided by an instructor he has not learned it thoroughly.

"4. The teacher should have some definite measuring system by which he is able to determine the progress of the student from the standpoint of appreciation, information and doing ability. Until the student has passed these three stages in the learning process he has not mastered what he set out to accomplish."

A careful perusal of these hints, shows that they are as applicable to the industrial-arts teacher as to the trade teacher.

Without definite objectives, industrial-arts work is of no account. The making of projects, merely as projects, has little or no value. Everything that the student does must be done for a specific reason and this reason must be known to both teacher and student. Unless this rule is strictly adhered to, industrial-arts work will be as hopelessly at sea as trade work given under the same circumstances.

The industrial-arts teacher also must be able to analyze a job and break it up into suitable teaching units, because if he has not this ability, he will be unable to build up a course in which the work is taught in a sequential order. Furthermore, he must be able to judge at least approximately how much time each job requires so that he can adjust his work to the time at his disposal.

Equally important is it, that the industrial-arts teacher be able to fit his instruction to individual cases, and that he be able to definitely determine the progress which his students are making.

All of this merely shows that the industrial-arts teacher and the vocational teacher are confronted by much the same job. Their work differs in degree, not in kind. Both are confronted with a serious and important job, both have a big problem to solve.

INDUSTRIAL ARTS FOR LEISURE

Americans, as a people, have more leisure than any other people. When the old twelve- and sixteen-hour day was discarded for the ten-hour day, and when the latter was then displaced by the present eight-hour day, most workers felt that great progress had been made. Then when the Saturday half holiday was instituted, it seemed that the limit of reduction for the working man's laboring time had been reached.

With the advance of modern production methods, however, this working week, much abbreviated as it is when compared to the working week of our forefathers, is apt to be shortened still further. As a matter of fact, some industries have already adopted the five-day-per-week plan. As time goes on, this short week with its two full-day holidays may be still further shortened, and education for leisure becomes a greater and greater necessity.

It is true, that as the leisure for adults and juvenile workers becomes greater, there will be more and more opportunity for the ambitious to work at one place for the full time, and take care of a part-time job at still another place. Nevertheless, there will be an increasingly large number who have to be trained in habits of industry to fill out time which would otherwise be spent in idleness.

One of the objectives of industrial-arts work has always been to develop hobbies. With the present trend of increased leisure, this objective becomes more important. Not only must the field of hobbies for the boy be carefully scrutinized for school projects, but the part which industrial-arts work plays in the life of the adult may profitably form the basis for serious study. The results of this study may then be introduced in the industrial-arts work which is offered the more advanced shop student, as real education for the profitable use of leisure.

Since, from all present indications, the shorter work week is inevitable, it is time that the school should recognize this condition at once, and make use of its present industrial-arts equipment to build for the future.

To make objectives vital means to emphasize them. This is exactly what must be done with the objective for the development, not of juvenile hobbies as that is already done, but of adult hobbies which will teach the adult to profitably employ time which might otherwise be spent in such a way as to do irreparable social harm.

SUCCESS AND FAILURE

Every shop teacher feels that he can foretell after a comparatively short contact with the members of his class, those who will make a success of the work which is being taught. It is quite natural, after he has decided who are to be the successes in his class, that he should specially favor them. The danger then, is that the favoring of those who already are superior will do much to widen the gulf which exists between

the so-called bright students and those classed as dullards.

In some classes, this condition may react detrimentally in two ways. The successes of the more brilliant may make them develop a complex of superiority, just as those who are failures, or near failures, may develop an inferiority complex which may ruin their entire lives.

The grave problem that confronts the teacher then, is to so adjust his work that it does not adversely influence either his successful students nor those that are not so successful. This means a great amount of extra work for the teacher who earnestly endeavors to perform his work in the best possible manner, because he is at once confronted with the problem of devising jobs, or series of jobs, which will satisfy the objectives of his course and yet will be worth while to both the bright and the dull student. What is more, the satisfaction of accomplishment must be experienced by the dull boy working at his simplified task just as does the bright student finishing his more complex job.

Above all, however, the teacher's attitude must be such that even his slowest pupil does not get the impression that the instructor has him cataloged as a failure. This means that the teacher must do his utmost to keep his faith in the ability of his students. His mental attitude must bolster up the self-confidence of the boy, and this coupled with actual accomplishment, even if that accomplishment may be only in the correct doing of one or a series of simple things, will give the student something that will spur him on to greater efforts. From small successes, the potential failure may then gradually develop the power to accomplish greater and greater things.

Of course here too, the teacher must be very circumspect lest the jobs be so simple that they do not seem worth while. No one feels that he has accomplished anything if he does something that to him seems trivial. The job must forever be a challenge to the individual and only when jobs which call for the best in each student have been provided, and if the teacher carefully checks that each individual in his class is putting forth his best effort on the job upon which he is engaged, only then can he feel that he is doing the utmost to prevent anyone in his class from being gravely injured by an excess of either failure or success.

SIZE MAY NOT MEAN EFFICIENCY

The school shops in large cities must necessarily accommodate a greater total number of students than the shops in smaller communities. This, taking care of superior numbers, of course, means a different organization than that required for only a few classes per week. It means different class management, different methods of taking care of details, different accommodations for storing tools and materials — in other words, a much more complex organization.

However, the very size which requires all these extra considerations, also may produce a simplification for convenience sake which is detrimental to the best teaching results. With so many to take care of, the temptation is to take the path of least resistance, use the class method, and run every student through on a standard schedule. While this may be the easiest way out, yet a conscientious shop teacher who really takes an interest in his students, will not adopt this method.

Of course, he, too, will look for simplification, but his simplifying will be the cause of painstaking deliberation and planning. His methods will be carefully tried out, and adopted only when they have proved themselves efficacious. He also will, and rightfully so, attempt to make his work as easy as possible, although this, too, must be studied with an eye to efficient instruction rather than to personal comfort. For this purpose, classroom processes must be carefully analyzed so that many of the simpler duties may be delegated to students, not only with a view toward lightening the teacher's labor, but to develop in the classes that spirit of leadership, coöperation, and initiative which really should be the by-product of all industrial-arts and vocational education.

Large classes, conducted in this more modern and efficient manner, may well be held up to the rest of the school world as a model to be imitated. The displays in such a shop will not show just a few samples of student work of the foot-scraper, screw-driver, ball-peen-hammer type, but will display a wide variety of projects which will appeal to the varied tastes represented in any large group of human beings.

If the work in the larger school systems is not developed and administered in the painstaking way just described, there is little excuse for the complacency often displayed by certain shop teachers who are teaching in these systems. Compared to some of the work that is accomplished in shops accommodating equally as many students per class as their own, although there may be less classes per week, the results obtained in the shops of some of the large city systems is decidedly at a disadvantage.

OPPORTUNITY

The actual fact is that in this day, opportunity not only knocks at your door but is playing an anvil chorus on every man's door and then lays for the owner around the corner with a club. The world is in sore need of men who can *do* things. Indeed, cases can easily be recalled by everyone where opportunity actually smashed in the door and collared her candidate and dragged him forth to success. These cases are exceptional, usually you have to meet opportunity half way. But the only place where you can get away from opportunity is to lie down and die. Opportunity does not trouble dead men, or dead ones who flatter themselves that they are alive. — *Elbert Hubbard.*

SPECIALIZATION

The trend of the times is so rapid that a man cannot be efficient in everything. One does not live long enough to learn much about the many things in life. Branches of training must be taught that will fit boys for the specialized work in industry. Each must choose his line of work and must be trained thoroughly in that line. Men must be trained along the line of their special fitness.—*E. J. Sunderland.*

Mathematics for the Junior-High-School Electric Shop

*Edward B. Flaherty**

1. Find the length of wire needed for a job, if the following lengths of wires were used: 4 ft. 2½ in., 2 ft. 6¼ in., and 1 ft. 1¾ in. *Ans.* 7 ft. 10½ in.
2. A journeyman electrician earns $1.25 an hour, and his helper earns 75 cents an hour. How much more per day of 8 hours does the electrician earn? *Ans.* $4.
3. A wiring job requires 3 ft. 8¾ in. of No. 14 r.c. black wire, and 1 ft. 11¼ in. of No. 14 r.c. white wire. Find the length of black and white wire needed for 15 similar jobs. *Ans.* Black, 55 ft. 11¼ in.; white, 29 ft. ¾ in.
4. In an electrical shop these lamps were used:

Ceiling lights	6 — 100-watt lamps
Store light	1 — 75-watt lamps
Booth lights	7 — 60-watt lamps
Desk light	1 — 50-watt lamps
Dressing-room light	1 — 150-watt lamps

   Find the total number of watts consumed. *Ans.* 1,295 watts.
5. An intercommunicating telephone has a battery of 4½ volts. How many dry cells, each having 1.5 volts, are connected in series to make up the battery? *Ans.* 3 cells.
6. Five lights are to be evenly spaced and wired in a straight row. If the distance between the outside lights is 2 ft. 9 in., what is the distance between centers of two adjacent lights? *Ans.* 8¼ in.
7. What is the cost of the following article?

2 vibrating bells	@ 32c each
2 buzzers	@ 31c each
4 push buttons	@ 8c each
2 door openers	@ $1.35 each
3 dry cells	@ 27c each
30 staples	@ 15c per 100
1/5 lb. D.P. office wire	@ 44c per pound

   Ans. $5.23.
8. Find the number of watts taken by a bulb if it is connected to a 110-volt circuit, and consumes 0.54 ampere of current. *Ans.* 59.4 watts.
9. A fan motor is rated at 75 watts. If it uses 0.68 ampere to run it, what is the line voltage? *Ans.* 110.3 volts.
10. An electric iron is rated at 575 watts. It is connected to a 110-volt line. How much current does it take from the line? *Ans.* 5.23 amps.
11. The name plate of a direct-current generator reads 5.5 kilowatts. How many watts is this equal to? *Ans.* 5,500 watts.
12. The reading of a wattmeter is 9,375 watts. Convert this reading to kilowatts. *Ans.* 9.375 kw.
13. How much would it cost to run a 250-watt soldering copper for a month of 22 days, 3 hrs. a day, if the cost of electricity is 8½c per kilowatt hour? *Ans.* $1.40.
14. Find the cost of operating a sewing machine for a month of 16 days, 2 hrs. a day. The motor consumes 0.34 ampere, and is connected to a 110-volt source. The cost of electricity is 8½c per kilowatt hour. *Ans.* 10 cents.
15. How many watts are required to operate a motor, if it is rated as 5 h.p.? *Ans.* 3,730 watts.
16. A certain motor takes 2,238 watts from the line. What is its horse power? *Ans.* 3 h.p.
17. A generator delivers 0.075 kilowatts. What is its equivalent horse power? *Ans.* 0.1006 h.p. say 1/10 h.p.
18. A generator delivers 10 kilowatts and a motor is rated at 10 h.p. What is the difference in their ratings in watts? *Ans.* 2,540 watts.
19. A dry cell has a resistance of 0.06 ohm, and it supplies 25 amp. of current. What is its voltage? *Ans.* 1.5 volts.
20. A wet cell has a voltage of 1.46 volts, and gives 4 amp. of current. What is its internal resistance? *Ans.* 0.365 ohm.
21. Find the current that is consumed by an electric heater which is connected to a 110-volt line, and has a resistance of 11 ohms. *Ans.* 10 amp.
22. A therapeutic carbon lamp consumes 2.37 amp., and has a filament resistance of 46.3 ohms. What is its rating in watts? *Ans.* 260 watts.
23. A transmission line has a power loss of 200 watts. If the current flowing through is 20 amp., what is the resistance of the line? *Ans.* 0.5 ohms.
24. A kind of wire weighs 200.9 lb. per 1,000 ft. What is the weight of 750 ft. of this wire? *Ans.* 150.68 lb.
25. An electrician in charge of a job is paid $75.00 a week. A journeyman electrician working with this man earns $55.00 a week. What is the ratio of their respective wages? *Ans.* 15:11.
26. There are 1,100 turns in the primary winding of a bell transformer, and its leads are connected to the 110-volt circuit. What is the secondary voltage, if there are 60 turns in the secondary winding? *Ans.* 6 volts.
27. The voltage of the primary winding of a bell transformer is 110 volts, and there are 1,100 turns in the winding. If the secondary voltage is 18 volts, how many turns are there in the secondary winding. *Ans.* 180 turns.
28. The voltage at the power station is 125 volts, and that of a far-away home is 115 volts. What is the percentage loss of voltage? *Ans.* 8 per cent.
29. An electrician bought a vacuum cleaner for $28.00. If he wishes to make 30 per cent profit, for how much should he sell it? *Ans.* $40.
30. An electrical supply company buys plug-type fuses at 3½c each, and sells them for 5c each. What is the gain per cent? *Ans.* 30 per cent.

*Warren-Bunker Hill School, Boston, Massachusetts.

31. The monthly electric bill was $1.75, but now by operating an electric radio, it amounts to $2.30. What is the percentage increase of the electric bill? *Ans.* 31.4 per cent.
32. A copper plating solution consists of 90 per cent water, 9 per cent sulphuric acid, and 1 per cent nitric acid. If the volume of the whole solution is 2 cu. ft., how many cubic inches does each occupy? *Ans.* 3,110.4 cu. in. water; 311.04 cu. in. sulphuric acid; 34.56 cu. in. nitric acid.
33. An electric bill of material amounts to $34.35. How much does a man have to pay if he is given 2 per cent for paying cash? *Ans.* $33.66.
34. The input of a motor is 746 watts, and the output is 537 watts. What is the efficiency of the motor? *Ans.* 72 per cent.
35. The motor of a motor-generator set is rated at 0.5 h.p. What is the mechanical horse power at the driving shaft, if the motor is 60 per cent efficient? *Ans.* 0.3 h.p.
36. The output of a motor is 1,120 watts, and it is 75 per cent efficient. What is the horse power of the motor? *Ans.* 2 h.p.
37. Find the sectional area of a 4-in. conduit. The outside diameter is 4½ in., and the inside diameter is 4 in. *Ans.* 3.33 sq. in.
38. Find the surface speed of a motor pulley which is 3 in. in diameter, and revolving 1,725 revolutions per minute. *Ans.* 1354.8 ft. per min. (or f.p.m.)
39. (*a*) Express in mils, the size of a copper wire which is 0.125 in. in diameter. (*b*) How many circular mils does this wire contain? *Ans.* (*a*) 125 mils. (*b*) 15,625 circular mils.
40. The cell of a flashlight is 1⅛ in. in diameter, and 2⅜ in. high. Find the number of square inches of zinc required for the making of its container. *Ans.* 9.37 sq. in.
41. The mean diameter of a coil of BX is 12 in. What is the length of the cable if there are 80 turns in the coil? *Ans.* 251.3 ft.
42. What is the volume of the liquid in a wet cell? The base forms a square 6 in. on each side, and the height of the liquid is 6½ in. *Ans.* 234 cu. in.
43. Find the weight of a switchboard bus bar which is ⅛ in. by 1 in. by 5 ft. One cubic inch of copper weighs 0.32 lb. *Ans.* 2.4 lb.
44. Find the diameter of an electric wire in inches. Its area is 250,000 circular mils. *Ans.* .5 in.
45. A portable heater is rated at 600 watts. Its resistance is 22 ohms. What is the amount of current it consumes. *Ans.* 5.2 amp.
46. Find the resistance of wire whose length is 100 ft. and its area is 4,107 circular mils. The resistance per mil foot is 10.8 ohms. *Ans.* 0.26 ohms.
47. Find the area of an electric wire which is 400 ft. long, and whose resistance is 2.66 ohms. The resistance per mil foot is 10.8 ohms. *Ans.* 1,624 circular mils.
48. Find the length of a wire which has a resistance of 0.393 ohms and whose area is 16,510 circular mils. The resistance per mil foot is 10.8 ohms. *Ans.* 600 ft.
49. The voltage at the generator end is 120 volts, and that of the load is 110 volts. If the load current is 50 amp., find the resistance of the line. *Ans.* 0.2 ohm.
50. Find the electromotive force of a dry cell which is delivering a current of 5 amp., and whose potential difference is 1.00 volt. The internal and external resistances amount to 0.1 ohm. *Ans.* 1.5 volts.

Perspective Drawing as the Introductory Step to Orthographic Drawings—V

*Frank W. Walsh**

(See Supplement No. 192)

DRAWING is one of the most accurate means of expression. It ranks with, and in some cases even excells writing in this respect. It is the language of the architect, the artist, and the man of industry. The progress of the race has been aided probably more by engineers, architects, designers, and artisans through this means of expression than by any other means. Their power to make visible their ideas by means of drawing things that have never been built, by means of drawings, has made possible the rapid progress of humanity in the past few years. The training necessary for such expression should be offered to every student in our schools today. When the wonderful inventions of the day are considered, one cannot help but feel that perhaps there have been many wonderful ideas lost and unexpressed which could have led to other valuable inventions simply because no graphic record of the original idea had been made.

*State Teachers' College, Oshkosh, Wisconsin. (Articles I, II, III, and IV appeared in the June and July, 1929, and in the January, and September, 1930, issues of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION.

Let us consider drawing merely as a means of expression, in the same manner as we consider all written and spoken words. There are spoken and written words that are understood by us because they express thoughts in a language known to us, while if they were in a foreign language, we would be unable to understand them. We acquire a foreign language by learning and applying its grammatical rules. We can follow the same procedure in learning drawing, the graphic language

The first article of this series dealt with this introductory phase of drawing under the heading "Perspective Drawing, the Mother Tongue of the Graphic Language." It shows this relationship of the types in the field of drawing.

This fifth article is to answer the question, "Why teach perspective drawing before teaching orthographic drawing?"

1. Perspective drawing pictures objects as they appear and are actually seen by all. Today we find that perspective drawings are made even in the kinder-

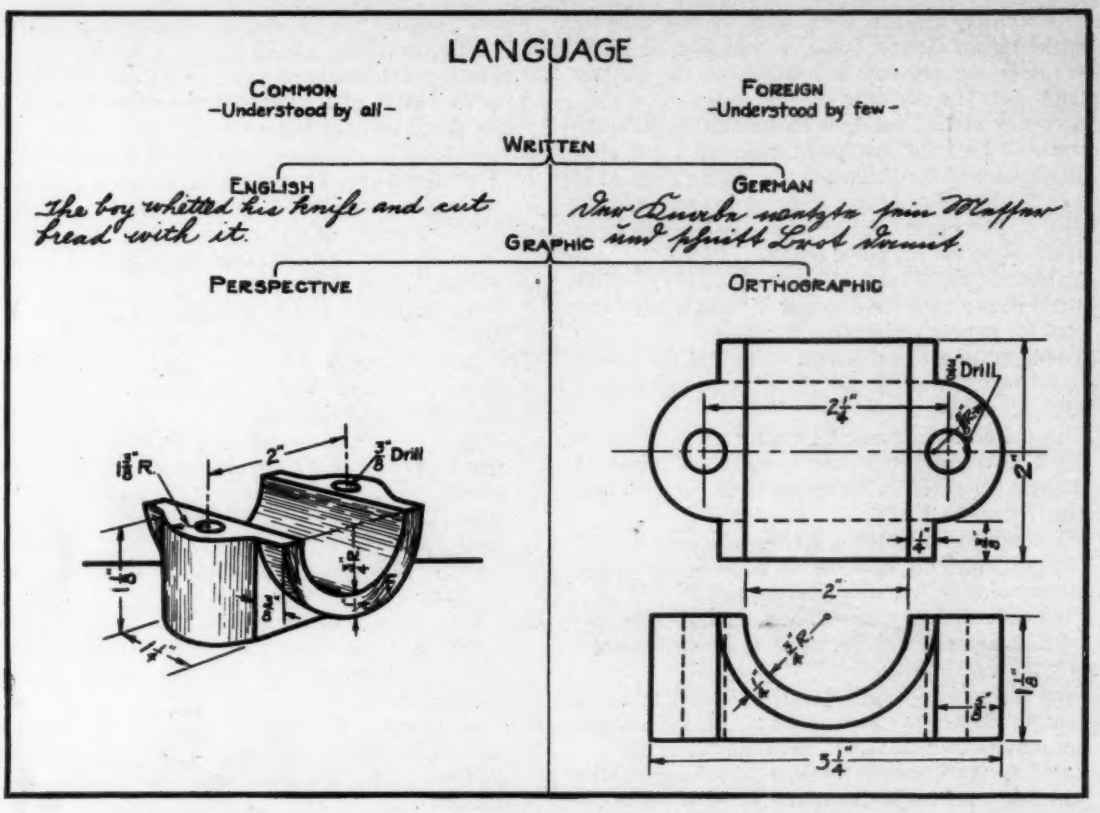


FIG. 1

garten. Each successive grade trains the student for more proficiency in this type of drawing. In the fourth or fifth grades, the student is given quite definite instructions in perspective drawing. All of this has been successful and proves that it is possible for every immature student to picture objects as they appear. A person making a drawing of an object, with the object before him, knows by comparison of his drawing with the object itself, whether he has been successful or not. The student making a perspective, is not required to make difficult "translations." He draws the object as a unit, and it is necessary for him to have but one view in mind.

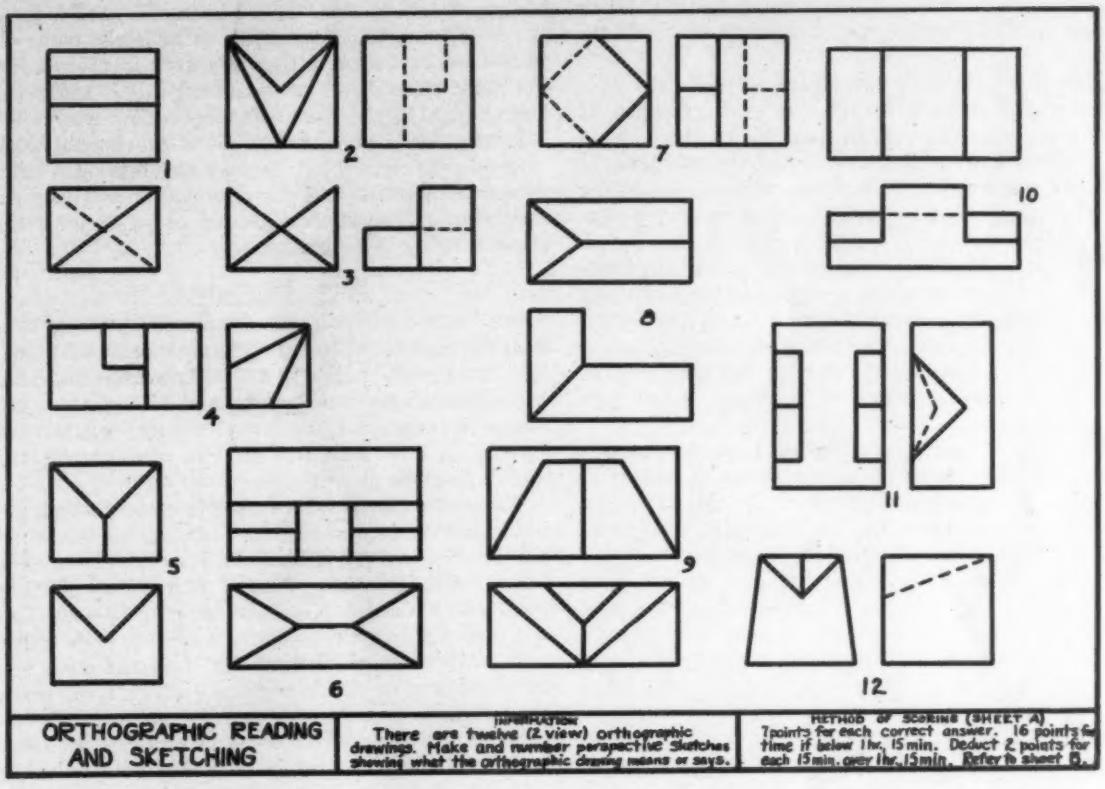
2. Because the elements of perspective drawing are taught in the lower grades, it affords a basis from which to proceed. All training in drawing in school will thus be related, and be more efficient, and there will be less wasted effort.

3. The ability to make perspective drawings gives a means of expression when the study of orthographic drawing is taken up. The student can "read" an orthographic drawing and express what he has "read," before he is called upon to "write" or make an orthographic drawing. He approaches the study of orthographic drawing by "reading" it first. He is required to "read" enough of it so that he can "read" it and express it easily and quickly by perspective sketches. After sufficient practice in this "reading" he is introduced to the drawing and making of his own orthographic drawings. This is similar to what we do when we study a foreign language, and this similarity is shown by the following drawings and sketches:

Figure 1 shows an English sentence and a German sentence meaning the same thing. A perspective drawing and an orthographic drawing meaning the same thing is also shown. The English sentence corresponds to the perspective drawing and the German sentence to the orthographic drawing. The student is led from the English, which he knows and understands, to the German. He is likewise led from the perspective representation which he knows and understands, to an understanding of orthographic drawing. It is first necessary that he understands the grammar or construction of the English sentence, so that he can make proper statements of what the German sentence means to him. In the same manner he must also be able to make perspective sketches good enough to properly show what the orthographic drawing means. This ability to express *what is read* is necessary for the same reasons in both. It is necessary to *translate* information from the foreign in both cases.

Figure 2 (Supplement 192) offers a simple test of this ability to read orthographic drawings. Four perspective sketches are offered from which to select a proper one for the orthographic drawing. This corresponds to a test which gives a German sentence and four English sentences from which to select the proper translation. This test is simple because the student can compare the orthographic drawing with the four different sketches which are all before him. A suggested means of scoring is given on the test.

Figure 3 shows another test of orthographic reading which is much more difficult because no sketches are offered and it is necessary for the student to make the proper sketches. If the student is able to *read and make* the proper sketches for this group of problems, he is sufficiently advanced in his *reading* to start *writing* orthographic drawings. The views that are taken in


1
2
7
10
3
8
4
5
9
11
6
12
ORTHOGRAPHIC READING AND SKETCHING
INFORMATION
There are twelve (2 view) orthographic drawings. Make and number perspective Sketches showing what the orthographic drawing means or says.
METHOD OF SCORING (SHEET A)
7points for each correct answer. 16 points for time if below 1hr. 15 min. Deduct 2 points for each 15 min. over 1hr. 15 min. Refer to sheet B.

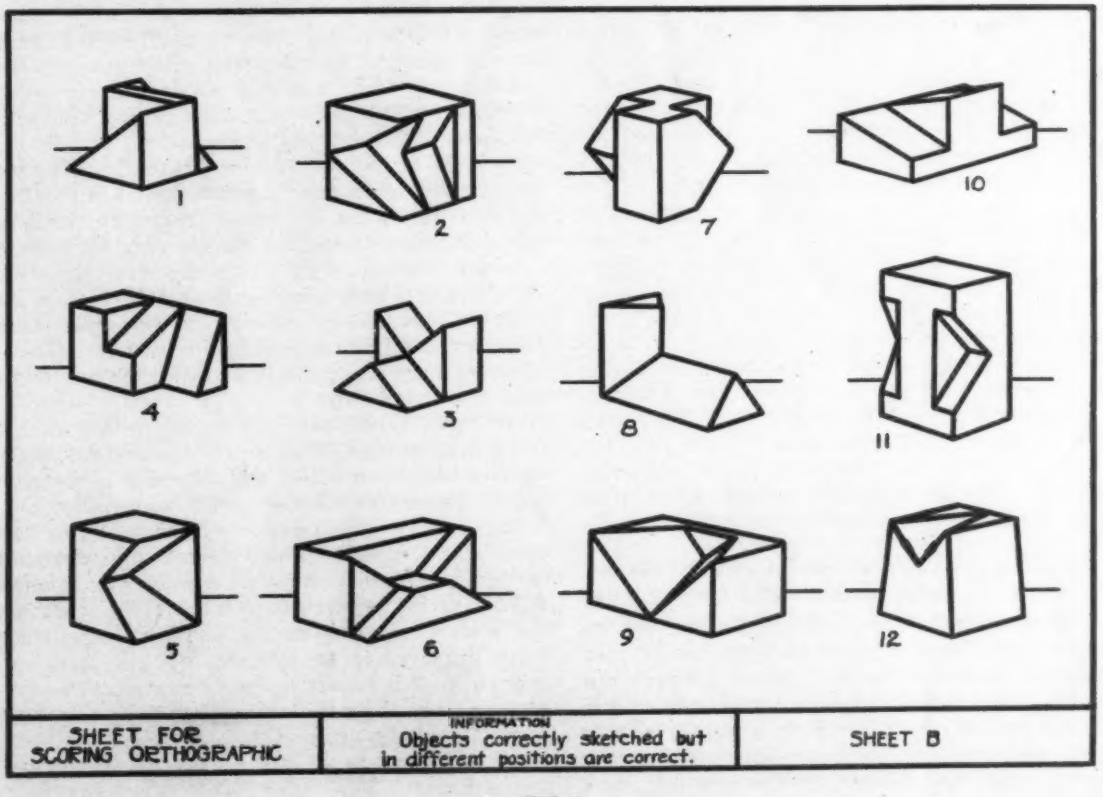

1
2
7
10
4
3
8
11
5
6
9
12
SHEET FOR SCORING ORTHOGRAPHIC
INFORMATION
Objects correctly sketched but in different positions are correct.
SHEET B

FIG. 3

these problems are not necessarily the ones that would be used in the working drawings but are made in such a way that only one correct sketch can be made for each.

Sheet B is added for convenience for those who wish to check their answers. However, to get the full benefit of the test with its resultant training, it is best not to refer to sheet B until all of the twelve problems of Figure 3 are drawn. The position of the object in the sketches that are drawn must not necessarily be exactly the same as those on sheet B.

Another test in this connection can be made by making perspective drawings of several objects and making four orthographic drawings to go with each from which selection is to be made. These tests and suggestions are made for the purpose of showing the simplicity of learning to *read* orthographic drawings before you *write* them.

The next step is to give perspective sketches, models or written information to the student to be *written* or drawn in an orthographic drawing. At this point the student is initiated into the special group of people who can *read* and *write* the technical language. From this point on, the student's training will be on more and more difficult orthographic drawings. His work will involve the making of *working drawings* of all kinds.

5. There is no reversal in the sequence of the subject matter covered. After the student has been *introduced* to orthographic drawing it will no longer be necessary for him to make perspective drawings, unless he finds it too difficult to make his orthographic drawings plain, and for that reason add a perspective sketch for the benefit of his readers.

6. Perspective drawing has proved itself of interest to the pupils, and this interest leads the pupil to attain more knowledge of the entire subject of drawing.

7. The instruments used in making perspective drawings require no more skill than those used for orthographic drawing. The equipment is simpler and does not require as high a degree of technique.

For the several reasons given in the foregoing, it would seem that it is much more logical, psychological and pedagogical, to begin with perspective drawing and lead to orthographic drawing. We know that many boys learn to swim by being thrown into the water. In the same manner, many of us learned to make orthographic drawings. We are *thrown in* without having had the benefit of a few *test strokes* first. Although the author learned orthographic drawing by partial views, models, etc., he is now entirely converted to the idea of *perspective sketching* of orthographic drawing first, and then *orthographic or technical sketches* from perspective drawings afterward.

DECORATIVE FINISHES ON METALS

Ralph G. Waring*

As a prevocational or junior-high-school subject sheet-metal work has occasionally proved unsatisfactory. In numerous instances failure has been due to the fact that the courses have been too limited in content and interest. It has been especially notable that the work produced has been inartistic and of little interest to the boys and to their families. Still, sheet metal offers many opportuiities of the finest educational types and involves opportunities for most interesting work in the design, construction, and finish of many articles like floor lamps, book ends, and artistic pieces of use to the boy and of value in the home. It should not be forgotten that this work involves all of the prevocational and informational values which the more limited types of sheet-metal products involve.

*The Tuscarora Laboratories, Syracuse, N. Y.

Decorative finishes in the field of sheet-metal work offer an opportunity for saving many otherwise commonplace pieces. It will pay any teacher to give some careful attention to the selection of finishes for the projects made in his classes.

Spray Equipment

For results approximating commercial work, it is desirable that the school shop be equipped with a one-half horse power compressor spraying outfit and with a small touch-up type of air gun. If funds are not available, then good brushes of the soft-bristle type, such as fitch or bear, will produce creditable results with high-grade glazing colors.

The metal must be cleaned before satisfactory finishing can be attempted. Finishing materials will not adhere to greasy galvanized iron, blue iron, sheet steel, or cast iron. A mere handling of these metals will give them a superficial oily coating, in spots at least. This spotting will cause the peeling of any applied finish, and, in the case of black or blue iron and steel, will be the reason for the development of rust spots under the finish.

Small articles may be cleaned by dipping, but larger articles, as a rule, must be scrubbed with a boiling solution applied with a short-handled fiber brush. To facilitate the handling of large quantities of small work, both for cleaning and drying, it is well to hang the articles on an annealed wire.

Antique Bronze. Apply a solid coat of copper bronze. Trim with yellow and red. Glaze all over with burnt umber and wipe out as desired.

Antique Dusting. After high lighting, and wiping out all excess glaze from the work, put a handful of powdered rottenstone in a double cheesecloth, tie into a bag, and bounce against a stick held near the work so as to dust the surface freely. Let dry hard, then clean off with a stiff shoe-polishing brush. If this does not smut the work enough, go over the whole piece with floor wax and immediately dust on the rottenstone. Allow it to dry hard; then polish with the brush or a piece of Brussels carpet.

Old Iron. Give a dead black brushing-lacquer coat as for Antique Rust. Trim with yellow and red. Glaze all over with burn umber and wipe out as much as desired. Smut with rottenstone for further effects.

The combinations possible with hard-drying lacquers, glazes, high lights, and colored trim are almost unlimited. The use of four-hour enamels *over* lacquers will also produce fine, clean trim lines. It is urged that the instructor make a careful study of the art-metal goods displayed in art, electric, and gift shops. An hour so spent is certain to supply new ideas and suggestions limited only in their application by a teacher's own ability, ingenuity, and skill.

Cleaning Metal Objects

The cleaning should be done with a solution made up of 4 oz. of a proprietary cleaner, 2 oz. of a 76-percent solution of caustic soda, and 1 gal. of boiling

water. This cleaning solution should be used boiling hot.

After the article has been dipped or scrubbed, it should be rinsed in clean, boiling water, and then immersed for a short time in a solution made up of 4 oz. of 66 per cent sulphuric acid, and 1 gal. of hot water. The acid should be poured *very slowly* into the water, stirring vigorously while so doing.

The articles should be dried without touching with the bare hands. If it is necessary to handle many pieces in finishing, then clean cotton work gloves should be used.

To prevent rust and to cause the final finish to adhere better, it is well to coat some articles with copper. If this is done, articles are first cleaned and "pickled" in sulphuric acid as suggested above. They should then be dipped in a solution made up of 4 oz. of copper sulphate, 2 oz. 66 per cent sulphuric acid, and 1 gal. of water.

This solution should be made by pouring the acid *very slowly* into the water, stirring constantly to prevent spatters. The crushed sulphate is placed in a cheesecloth bag and hung just below the surface of the liquid. The salt will dissolve many times more quickly if handled this way than if stirred into the water. This solution should be kept in a cypress tank, in a glass jar, or in an earthenware crock. A continuous band of light-gauge sheet copper encircling the tank and immersed in the solution will cause the latter to get more constant in use. If a lighter shade of copper deposit is desired, then ⅛ oz. of tin chloride should be added to the solution. The materials in solution of this kind are comparatively cheap and new batches should be made up as soon as there are signs of weak action.

The Glazing Process

Whether the metal is merely cleaned, or plated as suggested above, it is now ready to be decorated by the process known as "glazing." If a spray gun is available, a wide range of effects is possible. Brushwork distinctly limits the results, but entirely different finishes can be produced with a brush and rag. These are equally beautiful and interesting.

The purpose of glazing is to modify or tone down a bright color, to enhance the brilliance of a color which appears dull, or to impart the mellowness of age to a product which is otherwise too new or raw to be entirely satisfactory.

All colors cannot be used as glazes. Some are opaque, some are transparent, some bleed, others fade, while some are much too costly for large jobs. In any case, artists' tube colors will prove to be the most satisfactory and economical.

Glazing Colors

YELLOWS — Use raw sienna, French ochre; these are transparent, and make light and dark ivory, parchment, old ivory, etc. Chrome yellow, if used, must be very thin and well wiped out. An opaque color.

GREENS — Chrome greens, whether light, medium, or dark the most important. For olive greens, add traces of the yellows, warming with a trace of red if desired. Dutch pink is an olive yellow, excellent as a glazing color, is transparent, and is valuable for toning greens.

BROWNS — Burnt umber is a chocolate brown; raw umber and olive brown, both depending on the amounts of color used in the glazing liquid. Van Dyke brown is a rather warm color, deeper than burnt umber.

REDS — Burnt sienna is the best transparent, and permanent glazing color.

BLUES — Prussian blue is probably the most desirable for glazing work because of its great strength, and fair cost. Cobalt blue is lighter and more expensive. Ultramarine blue, redder than Prussian blue, is very fine for glazing, and medium in price.

BLACKS — Ivory drop black and carbon black are the two best suited for glazing purposes.

For glazing work of this kind, the artists' tube colors listed in the foregoing should be thinned with any standard "flatting oil" to the consistency of skim milk. In case the flatting oil is not available then use

Color, ground in japan	25 per cent
Turpentine	70 per cent
Japan drier	5 per cent

For high-gloss work, add 10 per cent of boiled linseed oil to the above.

Black and Gold. Apply a coat of black brushing lacquer to the clean metal, and let it dry hard. Then highlight all raised surfaces with gold bronze mixed with flatting oil or the regulation bronzing liquid. Make up a small cheesecloth pad, to the smooth face of which apply a small amount of the mixed bronze and apply lightly to the desired high lights. As a trim color, use red or green brushing lacquer or eggshell four-hour enamel.

Swedish Iron. Brush on a coat of aluminum bronze in clear lacquer, and let dry hard. Then apply a blue-black turpentine glaze over the entire piece, and wipe off the high lights before the glaze is dry, until the desired effect is secured. For hammered-iron work, rub with coarse steel wool or powdered pumice stone and kerosene until bright. Clean and pickle. When dry apply a coat of clear lacquer. After the lacquer has dried it can be glazed with the black and wiped for high lights. The general tone should be blue-black, with the polished metal showing through.

Early Italian. Treat the same as for black and gold; use a *dark* gold bronze, but trim with red and dull blue.

Polished Steel. Give one coat of light-gray brushing lacquer all over. Glaze the deep parts with black; highlight with aluminum bronze in bronzing liquid. Let dry, and give a coat of thin, clear varnish all over.

Verde Green. Give a coat of copper bronze in clear lacquer all over. Make up a light gray-green, from medium chrome green and ivory shaded gray, as a turpentine glaze. Apply with a very dry brush, spreading the color until the bronze shows through. Trim as for Early Italian.

Another method would be to make up a copper-colored brushing lacquer, apply all over, dry, then use a piece of old sponge, rather coarse in texture, to lightly stipple the green glaze over the undercoat. Judge this kind of work from a distance to avoid overdoing the green. Smut with a glaze of 1 part black and 1 part chrome yellow. Wipe almost clean.

Antique Rust. Give the work a dead black brushing-lacquer coat all over. Make up a rust-colored glaze of raw sienna with a touch of burnt sienna, and spatter on in dots from a long-bristle brush whose ferrule is tapped quickly against a hammer handle held a sufficient distance from the work to give the desired results. Stippling with a sponge will give results that are equally pleasing.

PROBLEMS AND PROJECTS

This department aims to present a wide variety of class and shop projects in the Industrial Arts and Vocational Education. Successful problems are invited and will be paid for. A brief description of constructed problems, not exceeding 250 words in length, should be accompanied by a good working drawing. The originals of the problems in drawing and design should be sent.

Problems in woodworking, turning, patternmaking, machine-shop practice, sheet-metal work, forging, foundry work, auto mechanics, auto electricity, electricity, architectural and mechanical drafting, printing, bookbinding, concrete work, farm mechanics, home mechanics, and other lines of industrial-arts work are desired for consideration.

A TOY HORSE AND CART

F. Clarke Hughes, Spokane, Washington

(See Supplement No. 191)

Transportation models are always to be depended on to interest and fascinate the younger boys. If the models are automatic or may be rolled about their market value in the eyes of the young owners is always raised very much.

The toy described in this article is realistic and practical, and the author has found it to be one that never fails to create a wave of interest in practically every class where the project has been presented. At Christmas time it is especially welcome as a seasonable class exercise.

To any of the experienced shop teachers a detailed account of the construction in this case is unnecessary as the problem is comparatively simple.

It is a problem that may, as a rule, be given to the ordinary beginner's class in woodwork or the usual fifth grade in the elementary school. If the instructor will study carefully the details of the drawing so that he has fixed in his mind the method of procedure, he will have no trouble in getting good results from this project with boys of any age.

It is suggested that this project be given as a community project and the different parts be made up as piece work on a quantity basis with the members of the class organized in small groups, and each group having its foreman or leader. The younger boys like this plan of production and as a rule get a lot of fun out of making the different small parts and finishing them up and counting them ready to be assembled when all is ready.

Bright colors should always be used in the finish, with reds, yellows, and white predominating.

A SUNDIAL

James W. Dockar, Menomonie, Wisconsin

(See Supplement No. 193)

The sundial is one of the earliest instruments used to divide the day into smaller periods than those indicated by dawn, noon, and sunset. Today the sundial is rarely seen, and then only as a garden ornament where accuracy is often disregarded. However, by considering the latitude of the location of the dial an accurate as well as ornamental timepiece may be constructed. Besides being used as a garden ornament, a sundial would make a very appropriate class present which would be a beautiful and useful ornament for any campus.

The spacing may be worked out by spherical trigonometry, but it is a long, complicated process. Geometrically, the layout is comparatively simple, and to make a good practical dial is within the capacity of any high-school boy. Sundials may be made of various materials. Wood may be used on which the dial is painted or carved; concrete, on which the lines may be inscribed while it is still soft; or a wood pattern may be made, which may then be cast in brass or bronze. The one illustrated was made of bronze.

— CORRECTIONS FOR SUNDIAL —

DATE	1ST	7TH	13TH	22ND	28TH
JANUARY	+4	+6½	+9	+12	+12
FEBRUARY	+14	+14½	+15	+11	+13
MARCH	+12	+11	+10	+7	+5
APRIL	+4	+2	+1	-2	-2½
MAY	-3	-3½	-4	-3½	-3
JUNE	-2	-1½	⊙	+2	+3
JULY	+3½	+4½	+5½	+6	+6
AUGUST	+6	+5½	+4½	+3	+1
SEPTEMBER	⊙	-2	-4	-7	-9
OCTOBER	-10	-12	-14	-15½	-16
NOVEMBER	-16	-16	-15½	-14	-12
DECEMBER	-11	-8½	-5½	-1	+2

THE SUNDIAL IS CORRECT WITH WATCH TIME ONLY FOUR DAYS EACH YEAR -- APRIL 15 - JUNE 15 - SEPTEMBER 1 & DECEMBER 24 - - - FOR OTHER DAYS ADD OR SUBTRACT IN MINUTES AS INDICATED ON TABLE

To make a dial, the first thing to do is to find the latitude of your locality. This may be found by consulting a good map of your town or county, or you may get it from your local surveyor. The directions on the diagram sheet ought then to be enough, except that if 7 p.m. and 5 a.m. lines are wanted they may be found by drawing the 7 p.m. line *parallel* to the 7 a.m. line and the 5 a.m. line *parallel* to the 5 p.m. line. These lines are often used to help out the scheme of design.

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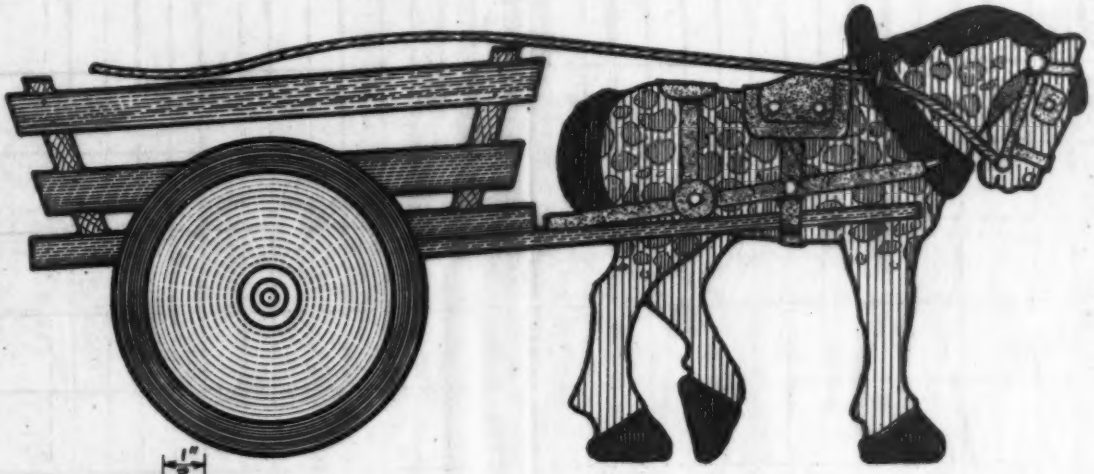
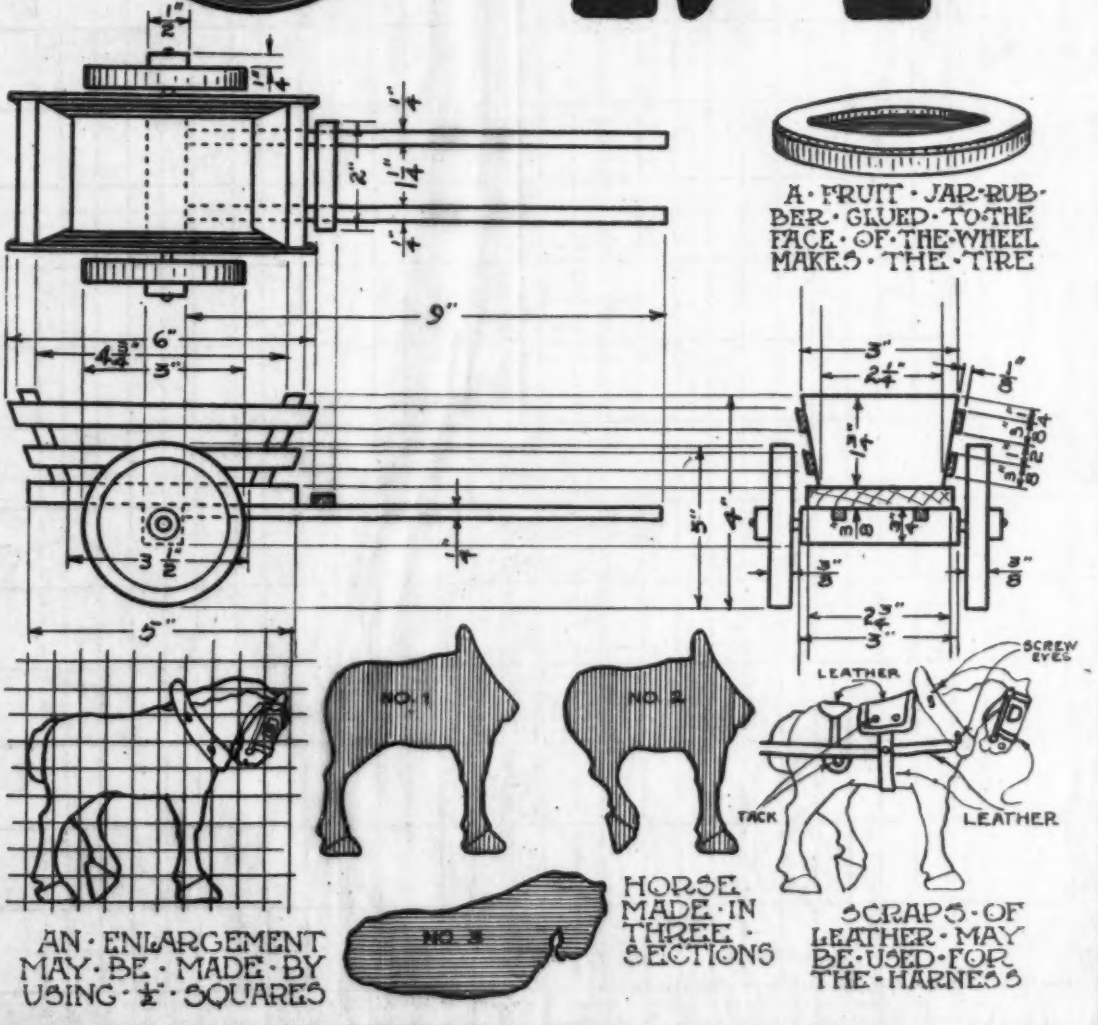
HORSE & CART

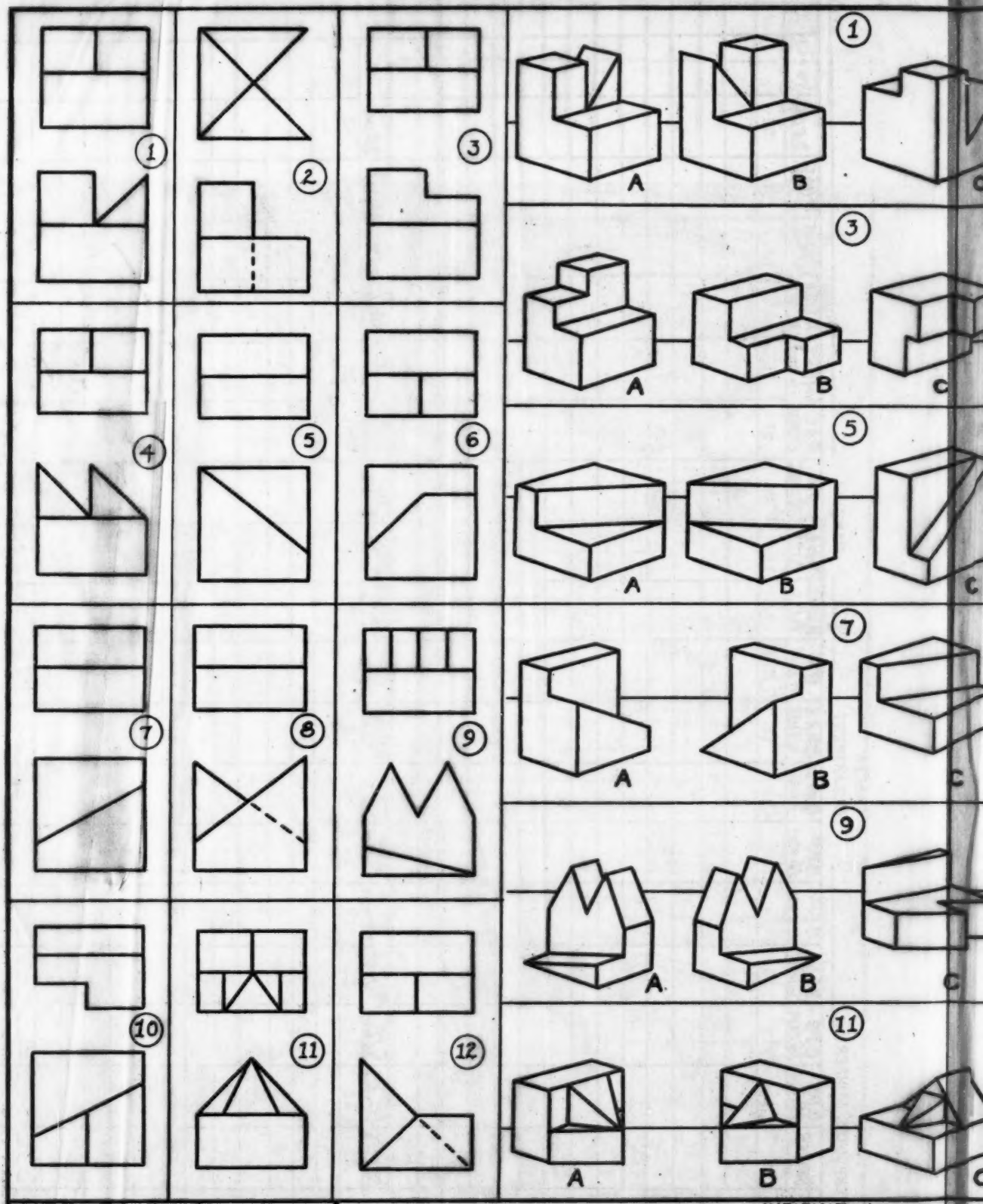



A · FRUIT · JAR · RUBBER · GLUED · TO · THE FACE · OF · THE · WHEEL MAKES · THE · TIRE
9"
6"
5"
SCREW EYES
LEATHER
TACK
LEATHER
NO. 1
NO. 2
NO. 3
AN · ENLARGEMENT MAY · BE · MADE · BY USING · ½" · SQUARES
HORSE MADE · IN THREE · SECTIONS
SCRAPS · OF LEATHER · MAY BE · USED · FOR THE · HARNESS

Designed by F. Clarke Hughes, Spokane, Washington.

For Description See Page 432, Industrial Arts and Vocational Education, November, 1930

TRACING SUPPLEMENT No. 192
INDUSTRIAL ARTS AND VOCATIONAL EDUCATION
NOVEMBER, 1930



ORTHOGRAPHIC READING TEST

INFORMATION

There are twelve orthographic drawings at the left. Att
drawings corresponding to them. Select and give the let
accurately pictures the orthographic drawing.

Designed by Frank W. Walsh, Oshkosh, Wisconsin.

Fig. 1

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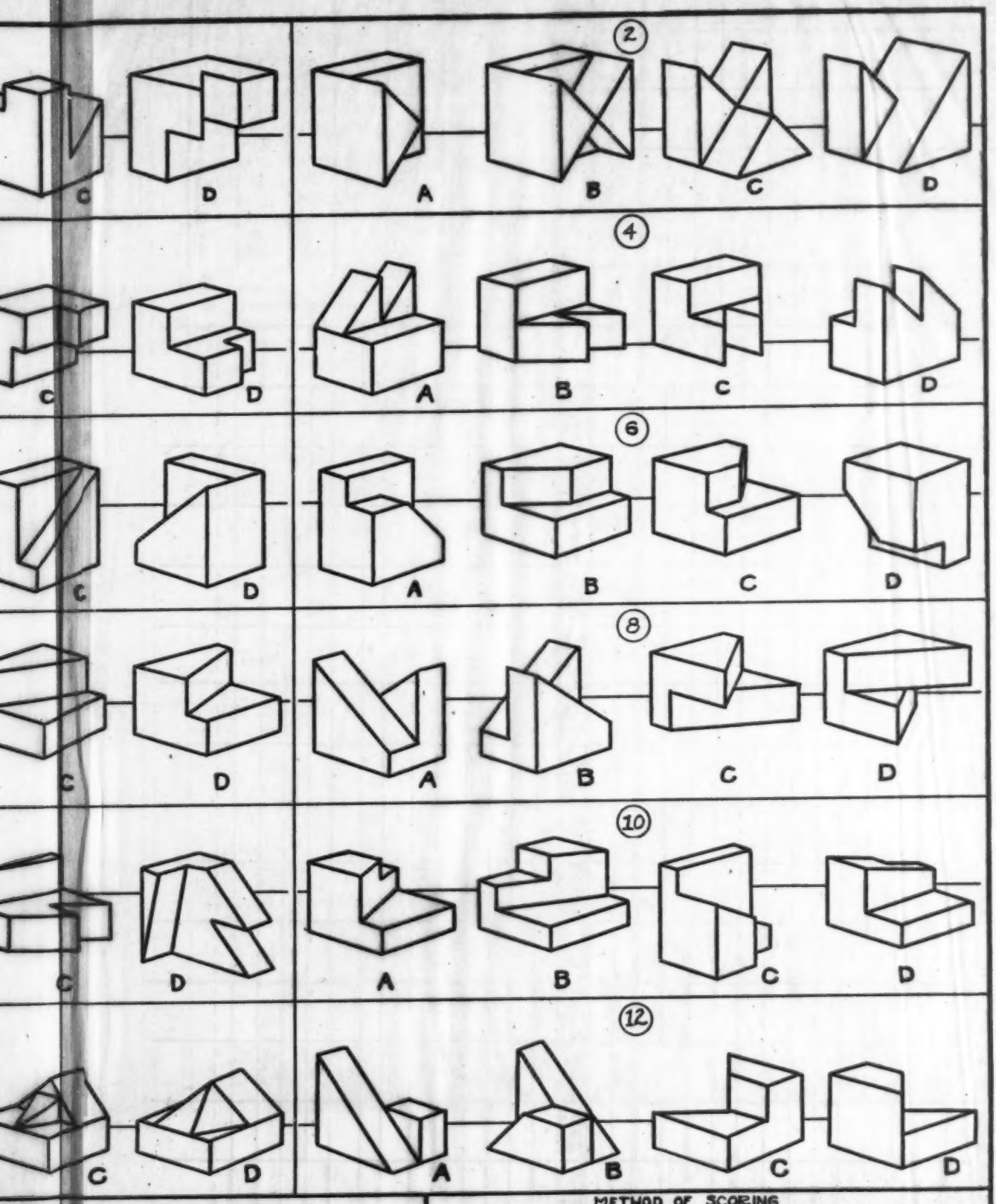

e left. At the right are twelve perspective
ve the letter A, B, C or D of the one which

METHOD OF SCORING

10 points for each correct answer above three. 10 points allowed for time below five minutes. Deduct one point for each minute above five. Time marking scale can be changed to suit grade of student.

For Description See Page 427, Industrial Arts and Vocational Education, November, 1930

TRACING SUPPLEMENT No. 193
INDUSTRIAL ARTS AND VOCATIONAL EDUCATION
NOVEMBER, 1930

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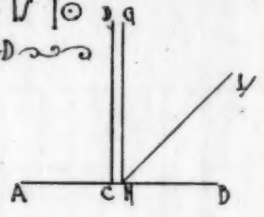
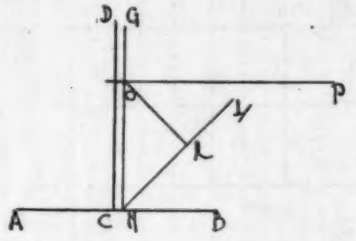
A SUNDIAL

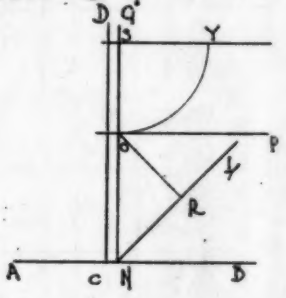
DRAW ANY STRAIGHT LINE A-B NEAR CENTER CONSTRUCT PERPENDICULARS C-D & G-N THE THICKNESS OF GNOMON APART --- CONSTRUCT ANGLE G-N-L EQUAL TO LATITUDE OF POINT WHERE DIAL IS TO BE ERECTED



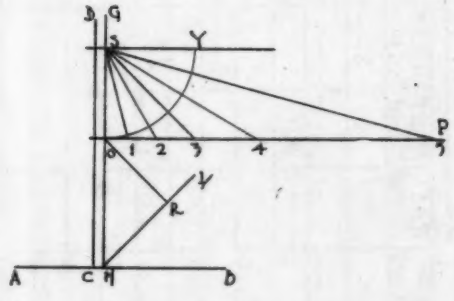
FROM ANY POINT ON N-L CONSTRUCT A PERPENDICULAR R-O MEETING G-N AT O --- DRAW O-P PARALLEL TO A-D



ON G-N MARK OFF O-S EQUAL TO O-R --- WITH S AS CENTER AND O-S AS RADIUS DESCRIBE ARC O-Y



DIVIDE ARC O-Y INTO SIX EQUAL PARTS AND EXTEND RADII TO MEET O-P AT 1-2-3-4-5



FROM POINT N DRAW LINES THRU 1-2-3-4-5 -- THESE ARE THE HOUR LINES - N-1 BEING ONE O'CLOCK N-2 TWO O'CLOCK ETC. --- QUARTER & HALF HOURS ARE FOUND BY DIVIDING THE FOUR EQUAL PARTS AND PROJECTING AS FOR THE HOURS

THE LINE A-D IS THE HOURS 7-8-9-10-11 SIMILAR MANNER ON THE OTHER SIDE OF GNOMON

SPACES ON ARC O-Y INTO SIX O'CLOCK LINE -- THEY ARE FOUND IN A

GNOMON

A-EQUALS LATITUDE OF POINT WHERE DIAL IS TO BE ERECTED

J.W.D.'30

HORAS NON NUMERO NISI SERENAS

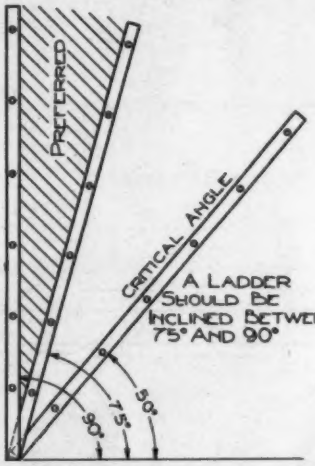
Designed by James W. Dockar, Menomonie, Wisconsin. For Description See Page 432, Industrial Arts and Vocational Education, November, 1930

The pedestal upon which the dial is set should be as simple as possible, because the dial is the center of attraction. Around the pedestal a simple appropriate motto may be inscribed, such as "I count only sunny hours." This translated into Latin, "Horas Non Numero Nisi Serenas" also may be used. Another appropriate inscription might be "The sun is the light of the world," or its Latin version, "Sol Est Gloria Mundi" may be used. If the pedestal is made of concrete the inscription may be worked in while the cement is still soft.

Generally the dial is set horizontally on a pedestal. If a vertical dial is desired, the complement of the latitude angle is used and it is set so that 12 o'clock is toward the bottom. When the dial is to be horizontal it may be set by consulting the table of corrections and when the standard time is as many minutes before or after 12 o'clock as the table shows for that particular day, the dial is moved so that the shadow falls on exactly 12 o'clock. Be sure the dial is absolutely horizontal, then fasten it permanently.

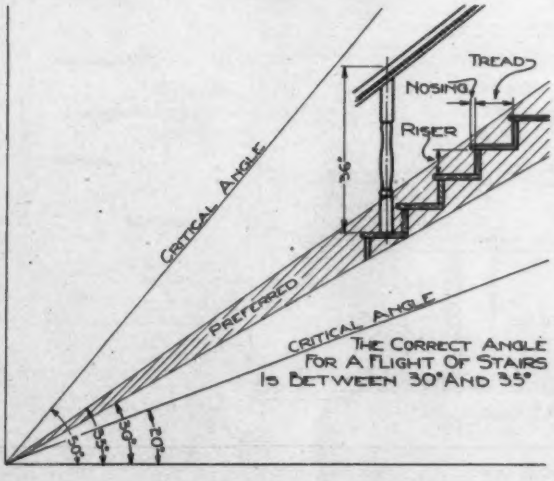
RELATED INFORMATION FOR WOODWORKING TEACHERS

Because stairways and ladders are dangerous, the following information taken from the January, 1929, issue of *Industrial Power*, may be of special interest to the teacher of woodworking, and especially of carpentry.



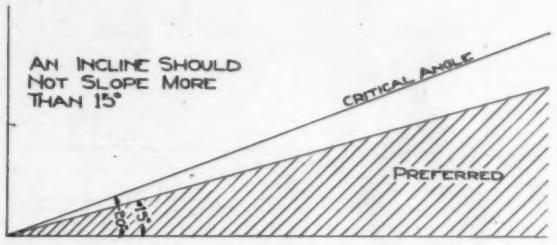
A ladder should be placed 75 deg. to 90 deg. from the horizontal for best results. If the angle is less than 50 deg., the ladder becomes dangerous.

The preferred slope for stairs lies between 30 deg. and 35 deg. from the horizontal. Uniform dimensions for the treads and risers in a given stairs are essential to safety.

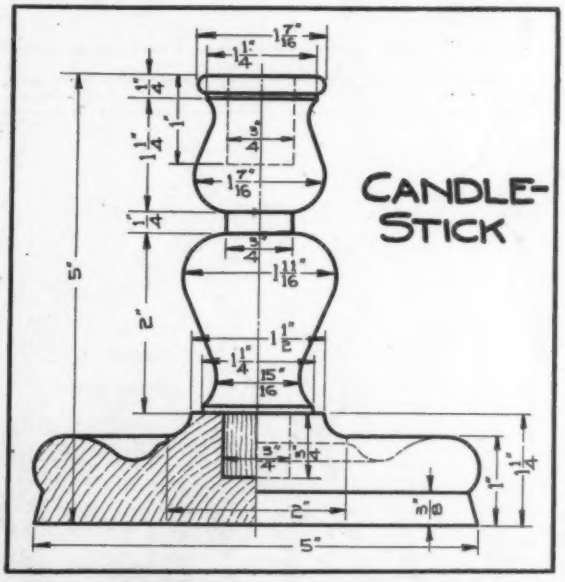


In the following table are given standard dimensions for risers and treads based upon a total value of riser plus tread equal to 17½ in. The preferred dimensions are shown in the boxed section.

Angle with Horizontal	Riser in Inches	Tread in Inches	Angle with Horizontal	Riser in Inches	Tread in Inches
23°—00'	5	12 1/2	36°—52'	7 1/2	10
23°—14'	5 1/4	12 1/4	38°—29'	7 3/4	9 3/4
24°—38'	5 1/2	12	40°—08'	8	9 1/2
26°—00'	5 3/4	11 3/4	41°—44'	8 1/4	9 1/4
27°—33'	6	11 1/2	43°—22'	8 1/2	9
29°—03'	6 1/4	11 1/4	45°—00'	8 3/4	8 3/4
30°—35'	6 1/2	11	46°—38'	9	8 1/2
32°—08'	6 3/4	10 3/4	48°—16'	9 1/4	8 1/2
33°—41'	7	10 1/2	49°—54'	9 1/2	8
35°—16'	7 1/4	10 1/4			



Ramps or inclines should preferably have an inclination somewhere between 0 deg. and 15 deg. An incline greater than 20 deg. is dangerous and slopes of even less than this should be covered with some antislip material.

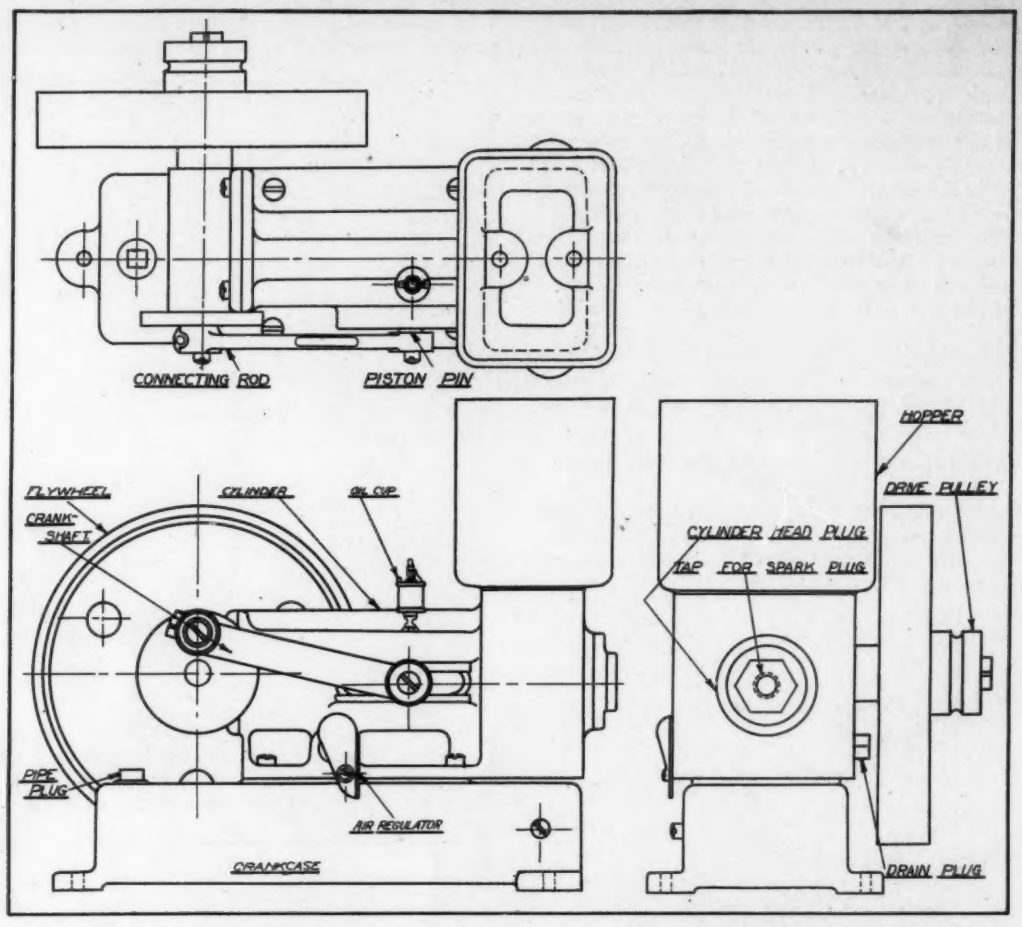


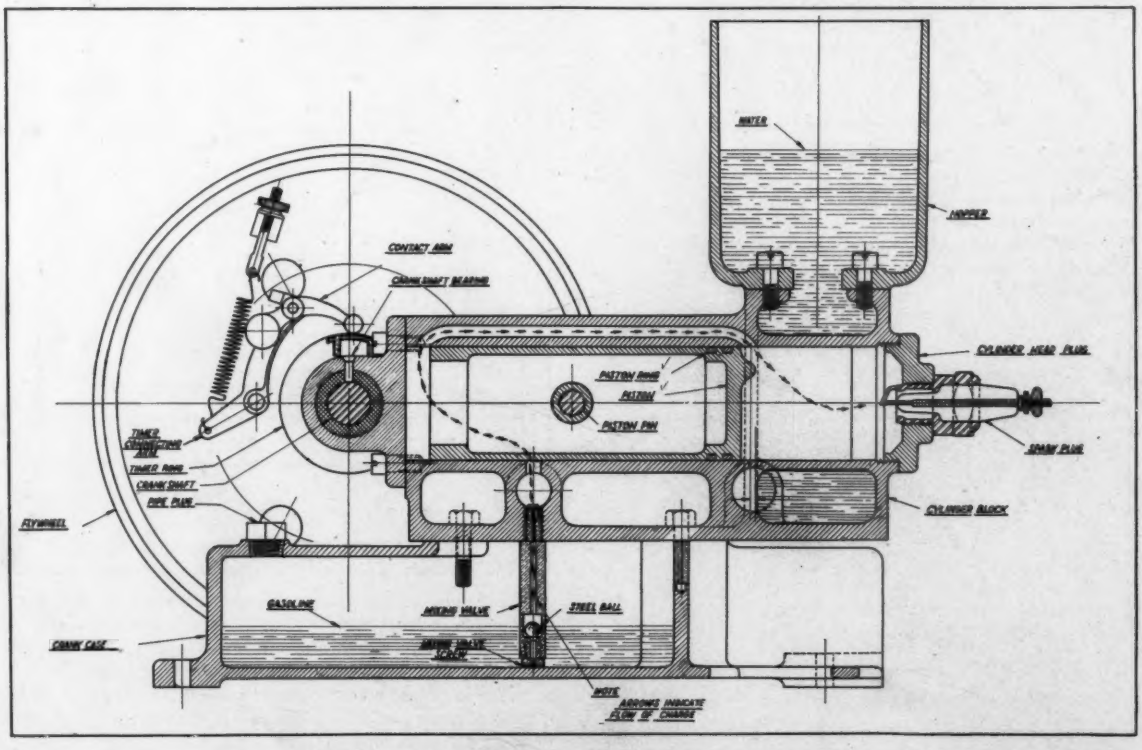
DESIGNED BY H. V. PATTERSON, SHAWNEE-MISSION HIGH SCHOOL, MERRIAM, KANSAS

ONE-HALF HORSE POWER GAS ENGINE

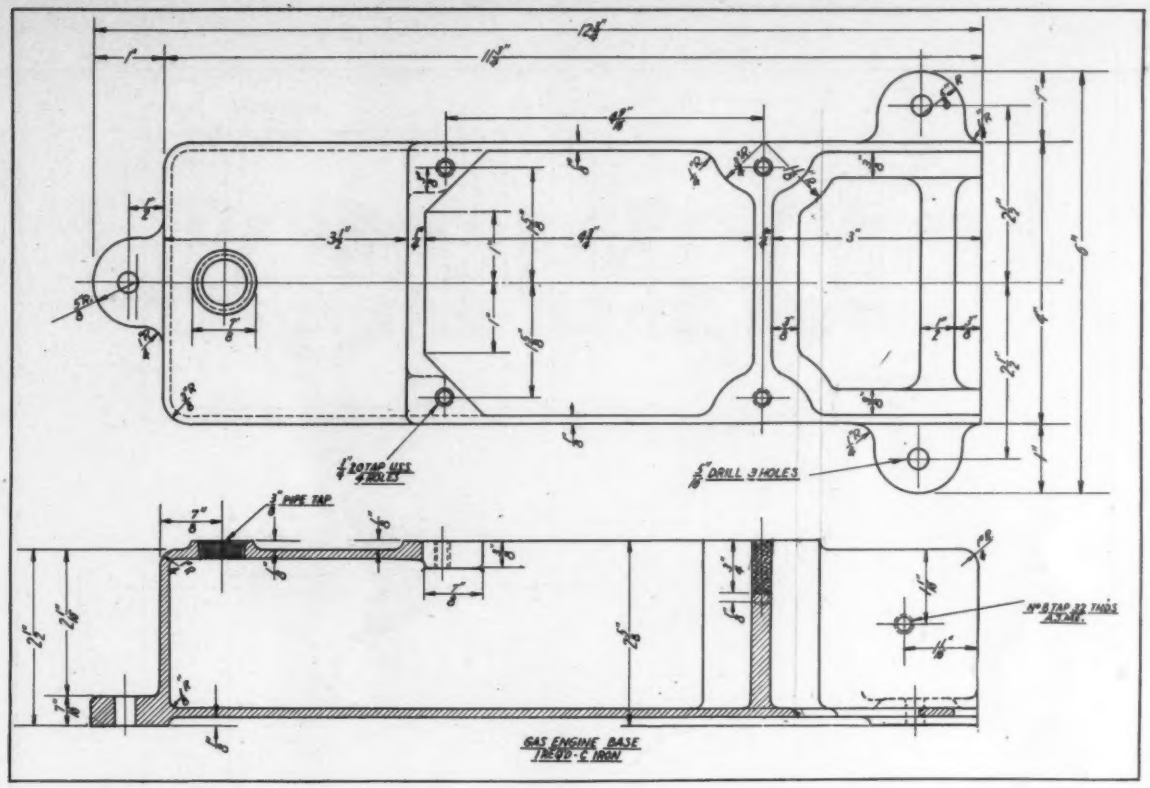
C. H. Niemann, Technical High School, Hammond, Indiana

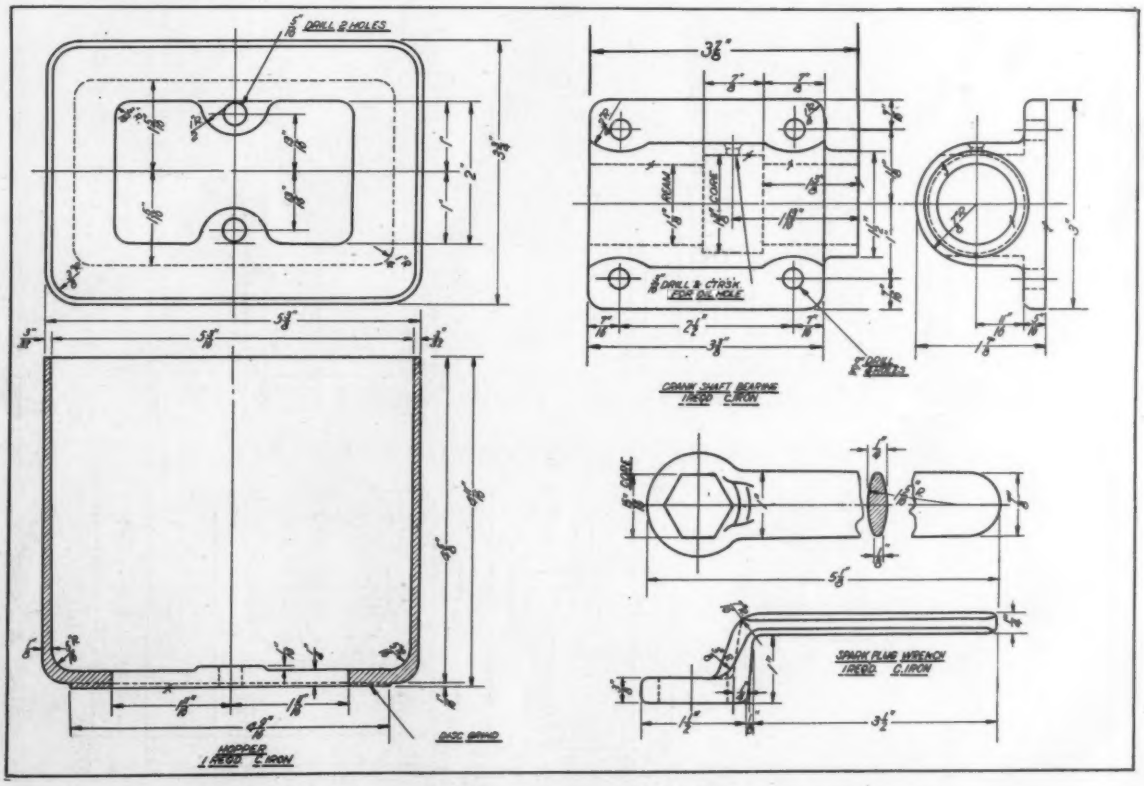
The details of the gas engine shown herewith offer some very good instructional material for advanced students in drafting, patternmaking, and machine-shop work. It is needless to say that the machining on this project must be very accurate in order to insure smooth operation. The only thing that is necessary to buy for this type of engine is the spark plug, as no carburetor is needed.



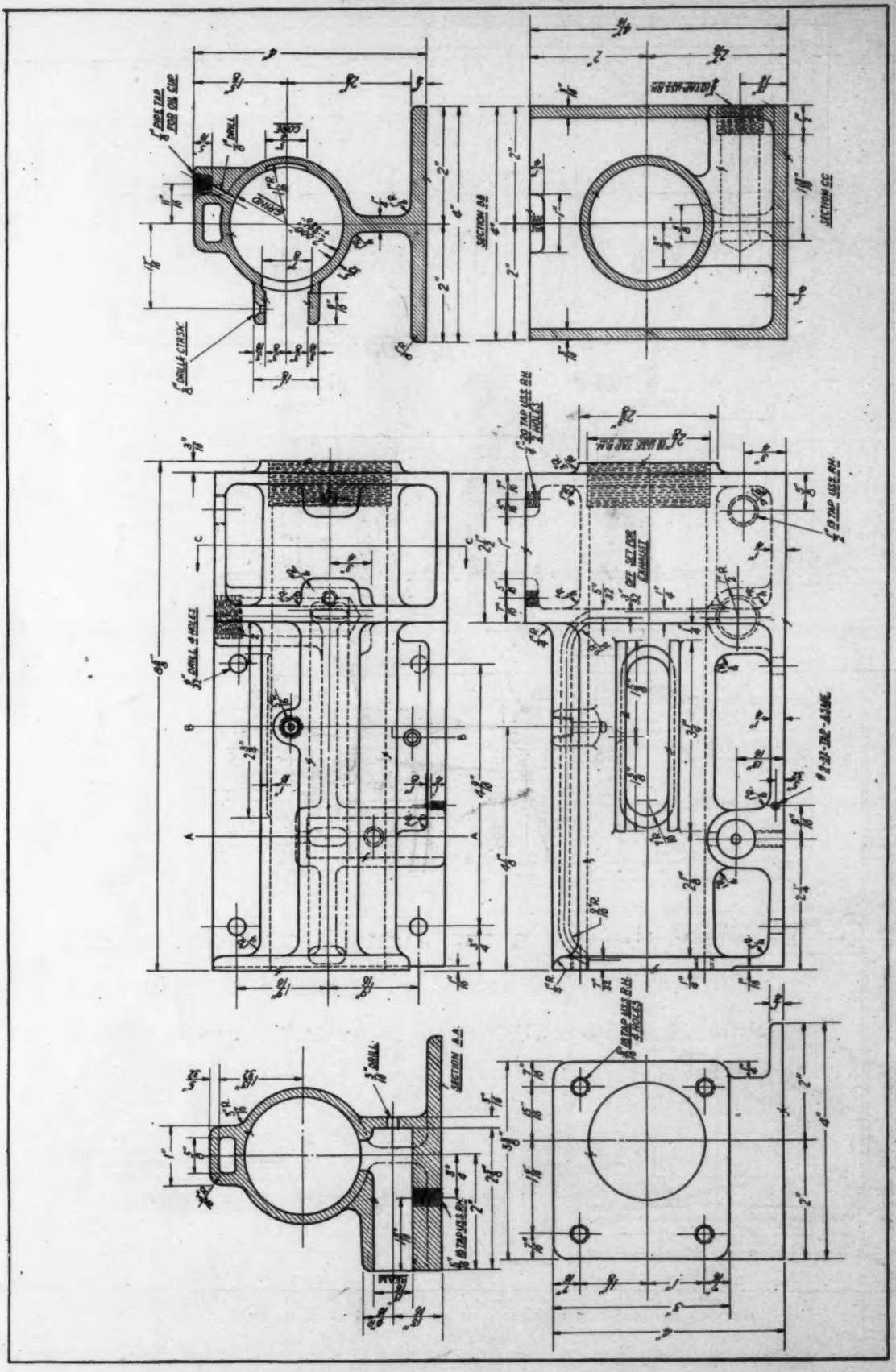


ASSEMBLY AND SECTIONAL VIEW OF ½ H.P. GAS ENGINE
DESIGNED BY C. H. NIEMANN, HAMMOND, INDIANA





DETAILS FOR GAS ENGINE DESIGNED BY C. H. NIEMANN, HAMMOND, INDIANA



DETAILS FOR GAS ENGINE DESIGNED BY C. H. NIEMANN, HAMMOND, INDIANA
(Additional details will appear in an early issue of INDUSTRIAL ARTS AND VOCATIONAL EDUCATION)

Dangerous Practices on the Band Saw

The boy shown in the above picture is trying to remove small blocks lying on the band-saw table. This is a dangerous practice and may lead to serious injury.

Don't endanger your fingers. Take a stick to remove anything that is near the saw blade.

Safety Series—Roy R. Van Duzee, West Allis, Wisconsin

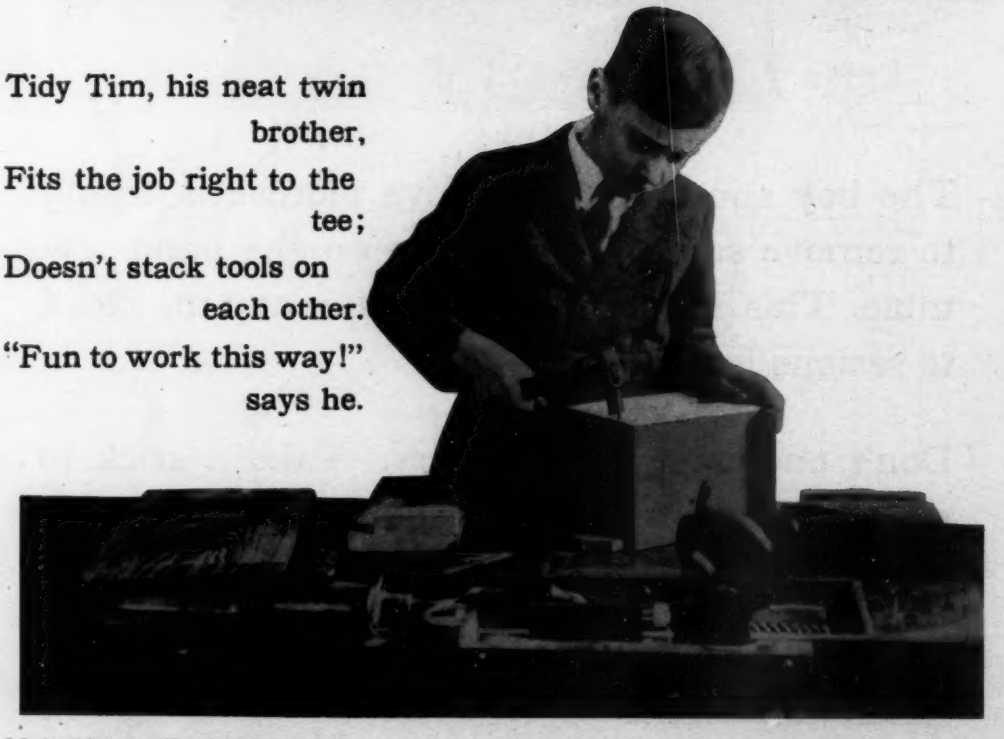
© Industrial Arts and Vocational Education

Tidyness vs. Untidyness

Submitted by Waldo C. Wright, Educational Director, Henry Disston & Sons., Philadelphia Pa.

Peter Potter likes to
putter,
Piles up saw and plane
and tool;
Knows much better,
doesn't bother,—
"Wonder where I laid
my rule?"

Tidy Tim, his neat twin
brother,
Fits the job right to the
tee;
Doesn't stack tools on
each other.
"Fun to work this way!"
says he.



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THE TRANSFORMER

(A Sample Informational Lesson for Students of Electricity)
H. Trelease, Principal, Essex County Continuation School for Boys, Orange, New Jersey

Principles of the Transformer. The stationary apparatus for transforming alternating currents is termed a "transformer." It consists essentially of a primary winding, a secondary winding, and an iron core.

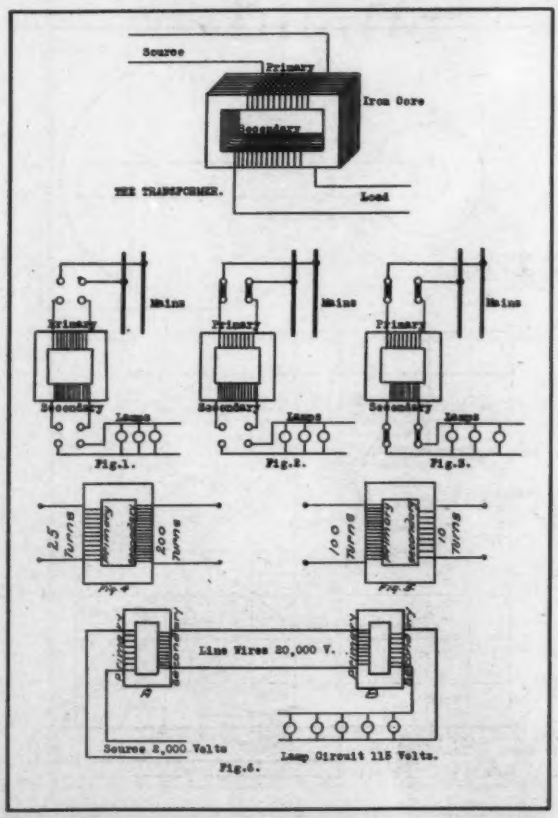
Alternating Currents. Among the properties of alternating currents is the facility with which they can be transformed from one voltage to another.

Transmission. Currents generated or transmitted at a high voltage can be transformed "down" to a low voltage, or these generated at a low voltage can be readily transformed "up" to a high voltage; all this can be accomplished without recourse to any revolving machinery, provided the currents are of the alternating kind.

Power. The power in any electric current is always the product of two factors, the *volts* and *amperes,* and the product of the volts and amperes called *watts,* 1,000 watts being called one *kilowatt.* Now, in any transformation it is impossible to get more power out of the apparatus than is put into it; in fact, as there is always a slight loss due to *resistance,* etc., the efficiency of even the best transforming apparatus is less than 100 per cent. In an electric transformer, power is put into the apparatus at one side called the *primary side,* and an equal amount (save for the small percentage of loss) is taken out the opposite side called the *secondary side.*

The Core. The core is made up of thin sheets of annealed steel punched to the proper form and size. The object of this is to reduce to as small a value as possible the currents that are induced in the core, known as *eddy currents.*

Operation of a Transformer. The three stages of operation of a transformer are indicated by diagrams, Figures 1, 2, and 3. At Figure 1, the transformer is disconnected from the supply mains and the secondary coil is disconnected from the circuit of lamps. The transformer will be quite inoperative. There will be no current flowing in either coil, and no waste taking place.



At Figure 2 the primary coil has been connected to the supply mains, but the circuit of lamps is still disconnected from the secondary coil. No current will be flowing in the secondary coil, but an alternating voltage will be produced in it, due to the flowing of magnetism produced by the primary coil. The self-induction of the primary coil is now at its maximum, and produces a back voltage, and of such a value that only sufficient current to produce the flow of magnetism can flow through the primary winding. This flow is called the *magnetising current* of the transformer. If the design is good it will be a very small flow, at this stage there will be a continued heating loss due to this small magnetising current passing through the primary coil, and also to the hysteresis and eddy currents produced in the core by the alternating flow of magnetism.

At Figure 3 the circuit of the lamps has been connected to the secondary coil, and a flow of current is taking place through the winding to the lamps. It will be noticed the two coils are not connected to each other, but form two distinct and separate windings, when the alternating current is supplied to the primary coil, each rise and fall and reversal of this current will act upon the secondary coil, and a similar alternating current will be produced in the secondary coil and the circuit of lamps attached to it.

Ratio. A transformer having the same number of turns in its primary and secondary coils would be called an equal ratio or one-to-one transformer. If the coil has twice as many turns as the other, the transformer would be called a two-to-one transformer, because the voltages would be in that ratio. Either coil may be made the primary coil.

Step-Up Transformer. If the secondary coil has less number of turns than the primary, it is said to be a step-down transformer, Figure 5.

Open Circuit. If the primary coil is connected to the mains, but no load is on the secondary coil, the transformer is said to be on open circuit.

Closed Circuit. When the secondary coil is supplying current, the transformer is then on closed circuit.

Automatic Operation of Transformer. The transformer is automatic in another sense also, that is, when the secondary circuit is left open, so that no current flows in it, there will be a voltage induced in it by the alternating flux interlinked with it. When the secondary coil is thus on open circuit, the current that flows through the primary coil from the alternating mains will be merely a magnetising current of small amount. When the secondary circuit is closed through a resistance, there will be a secondary current, and it will give out power and heat the resistance through which it flows. This power must come from somewhere, and the only way from which it can come is through the primary circuit by more current flowing through the mains. So as more current is drawn from the secondary side, so, automatically, does more and more current flow into the primary side from the mains.

Long-Distance High-Voltage Transmission. Two transformers, used to transmit electrical energy over a considerable distance, are shown in Figure 6, where for the sake of economy in the size of the line wires, the voltage is made very high, and the current therefore reduced to a very small amount. As the high voltage would not be suitable for the consumer, a second transformer is connected to the main wires, and the electrical energy is transferred to a distributing circuit, where it flows at low voltage but increased current.

Transformer *A* receives the energy from the generator at 2,000 volts pressure in its primary coil; it is there transferred to the secondary coil of *A,* where the voltage is raised to 20,000 volts, the flow of current being correspondingly reduced. Transformer *B* receives the energy in its primary coil at 20,000 volts, it is then transferred to the secondary

coil of *B*, from which it is distributed to the consumer at 115 volts pressure.

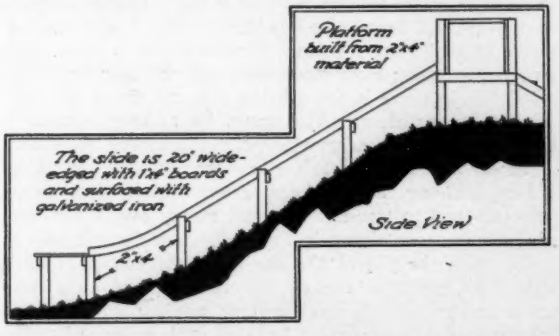
Transformer *A* is a step-up and *B* is a step-down transformer. The transformers shown in the diagrams are for single-phase alternating current. The general principle is the same in transformers supplied with polyphase alternating current, but the construction and arrangement of the coils and core will vary according to the number of currents and the method of connection adopted; sometimes several single-phase transformers are used in place of one polyphase pattern. They would be connected so their coils were linked to suit the particular system.

A HILLSIDE SLIDE

Dale R. Van Horn, Lincoln, Nebraska

Parks are usually equipped with a built-up slide for the youngsters when often there is a convenient hillside which will save nearly half of the cost if the slide is built there. At any rate, most of the supporting timbers can be eliminated as well as the steps. To reach the top from the bottom, steps can be cut in the hillside, or steps of concrete can be laid. If the slope is not too steep however, steps will not be needed.

The illustrations show such a slide which is a delight to the youngsters. By using this plan it is possible sometimes to double or treble the length of the slide at very little cost.


Platform built from 2"x4" material
The slide is 20' wide- edged with 1"x6" boards and surfaced with galvanized iron
Side View
2"x4"

A platform at the top is made of 2 by 4-in. pieces with a railing on the sides and steps leading up from the rear. From the front the slide extends downward. This is made of rough lumber laid on top of 2 by 4-in. pieces which are nailed across the tops of 2 by 4-in. stakes set in the ground 22 in. apart. The slide is edged with 1 by 4-in. boards and the bottom is covered with galvanized iron or zinc.

The lower end curves gradually to a horizontal level before terminating. In the slide shown, a horizontal stretch of 6 ft. was found sufficient to slow down the slider so that he could land on his feet without falling over. On higher or steeper slides, this section should be increased in length proportionately. The edges of the metal top are bent over the edges and tacked down before the 1 by 4-in. boards are nailed on so as to prevent any possible accident from this source. The side boards should be well sandpapered on the top and inside to prevent slivers. A sand pile may be provided at the lower end to make softer lighting. If the slide is used at the "old swimmin' hole" water should be piped to the top, so that the slide may be wetted before it is used.

BLUE-JAY ASH TRAY

Ralph P. Hummell, Washington High School, Washington, Pennsylvania

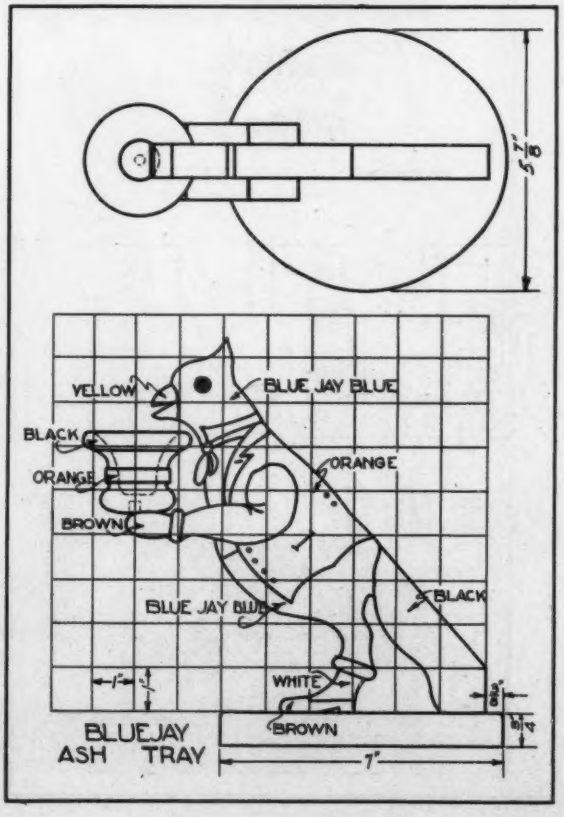
This rather unique ash tray became quite popular in my classes. The first step is to make templates of heavy drawing paper of the body and arms of the blue jay. The body is then made of ¾-in. stock, and the arms of ½-in. stock. Trim the arms to represent the half-round effect of the real arm and place a piece of ¾-in. stock, cut to match, between the hands.

It is best to fasten the arms after the tray has been turned so as to provide the clearance which it requires.

The tray is turned in the form of a hat, 1¾ in. high, with a brim 2¾ in. in diameter. It is placed on a small piece of ¼-in. dowel pin which is fastened to the hands.

The blue jay is mounted on a wooden base made in the shape of an oval with the top edge slightly rounded. This base may be finished in natural color, if white wood is used. It is fastened by a screw into the end of the jay's tail, and two small nails are driven through the front of the shoe.

The color scheme can be worked out as desired by the student. A very good effect is obtained by outlining the coat, collar, tie, cuffs, shoes, socks, and pants with a narrow black line. Tube oil paints are then used to color the rest of the figure.



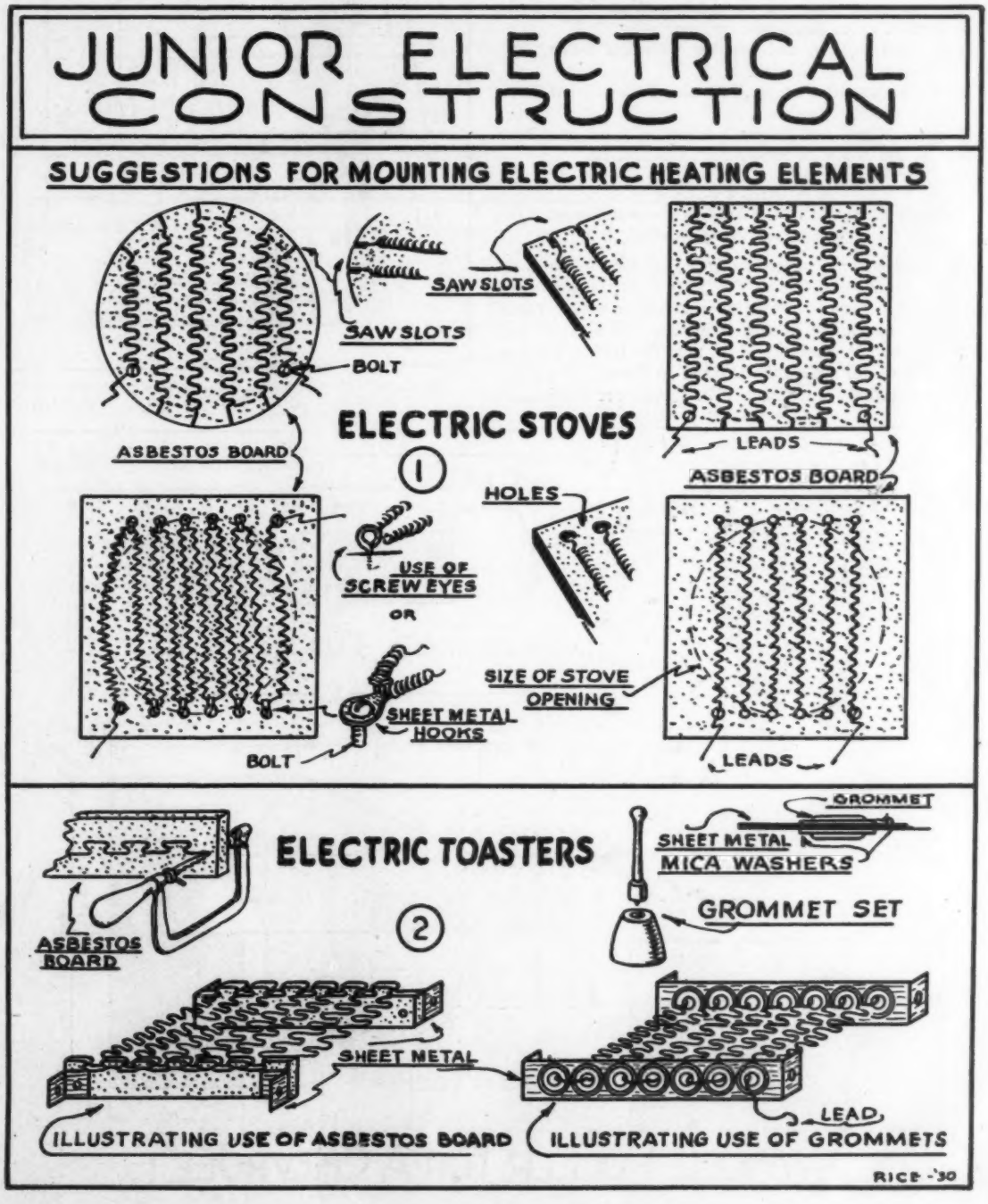
CONSTRUCTION HINTS AND HELPS FOR THE ELECTRICAL INSTRUCTOR

Charles M. Rice, North Junior High School, Everett, Washington

In the following material, the suggestions are offered with the intention that they might aid in the development and design, as well as motivate interest in simple electrical construction, in school shops.

In the first part of the illustration which accompanies this article will be found four ways of mounting electrical heating elements for simple electrical stoves, etc. The elements are made of nichrome wire or ribbon (see bibliography), and may be held in place by saw slots in edges, holes through the surface, or by sheet-metal hooks or screw eyes anchored to the asbestos board. The shape of the asbestos slab may be round, square, or oblong, whichever shape will best suit the conditions which confront the designer. The surface is divided in such a way that the element coil may be arranged within the allotted space. The ends of the element are fastened to stove bolts or machine screws, to which the electric appliance cord may be fastened.

In the second part of the illustration two methods quite different from those above, are given. One method shows the element ribbon or wire held in place by pieces of asbestos board which have projecting lugs along one or both edges. These lugs may be sawed out with a coping saw, and the pieces supported in a horizontal or vertical position by sheet-metal angle pieces.



The other method shows the element ribbon or wire supported by sheet-metal strips and insulated by mica washers held in place with brass grommets. Holes are first drilled in the metal strips large enough to take the grommets, then, with a mica washer on each side of the metal, the grommet is inserted and fastened with the punch. The grommets may be purchased from dealers handling tent or awning maker's supplies.

Bibliography of helps for electrical instructors, which may be had free for the asking:

"Nichrome and other Alloys for Electrical Resistance," Driver-Harris Co., Harrison, New Jersey. Contains useful data and instructions.

"Ambler Asbestos Products," Keasbey and Mattison Co., Ambler, Pa.

"Machines and Tools for Sheet-Metal Work," The Peck, Stow & Wilcox Co., Southington, Conn.

"First Quality Tools and Supplies," William Dixon, Inc., 32 E. Kinney Street, Newark, N. J.

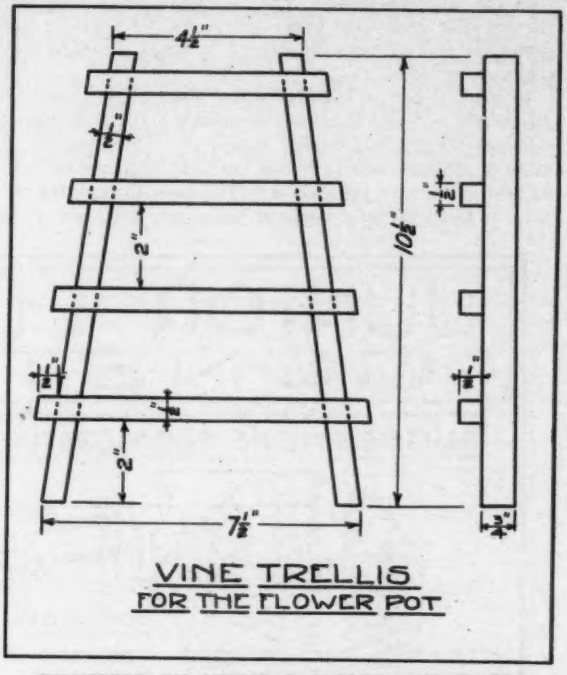
"Parker-Kalon Drive Screws," samples, Parker-Kalon Corp., 200 Varick Street, New York, N. Y.

"Electric Wires and Cables," American Steel and Wire Company, 208 South La Salle Street, Chicago, Ill.

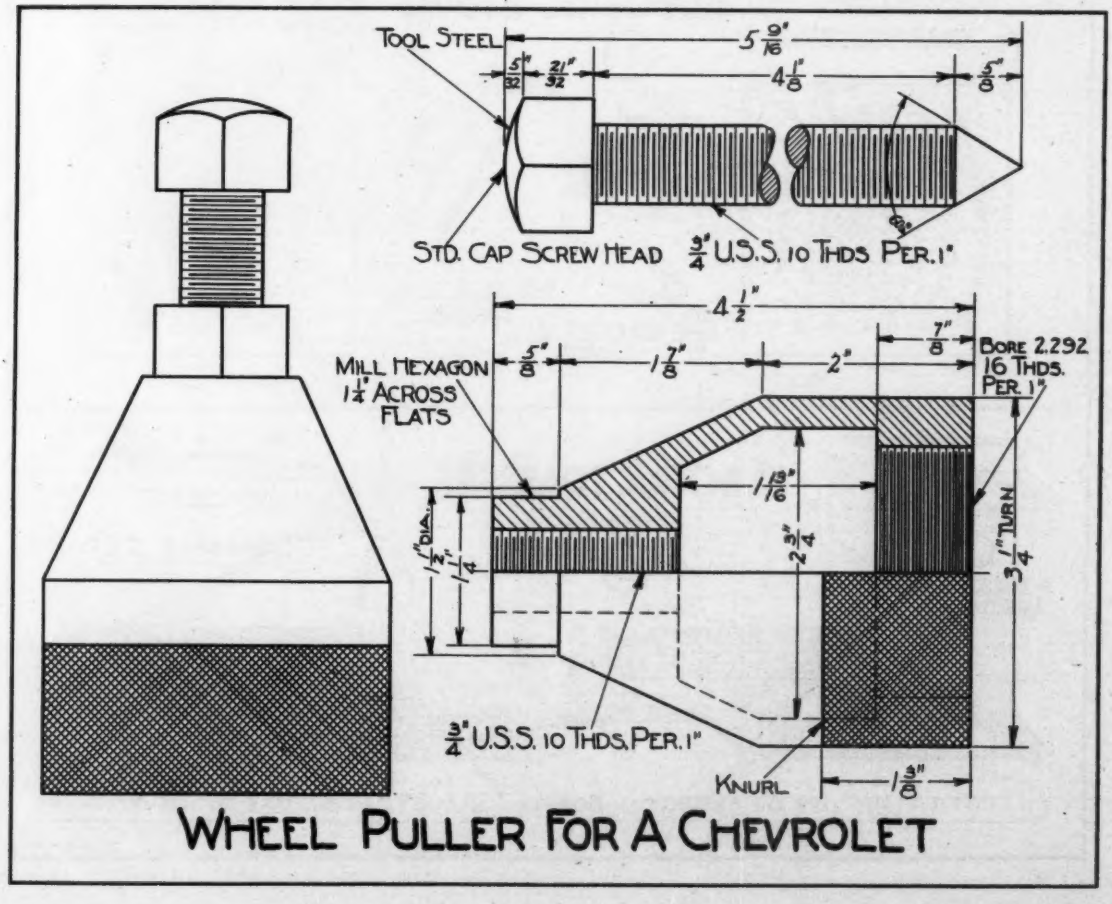
A WHEEL PULLER

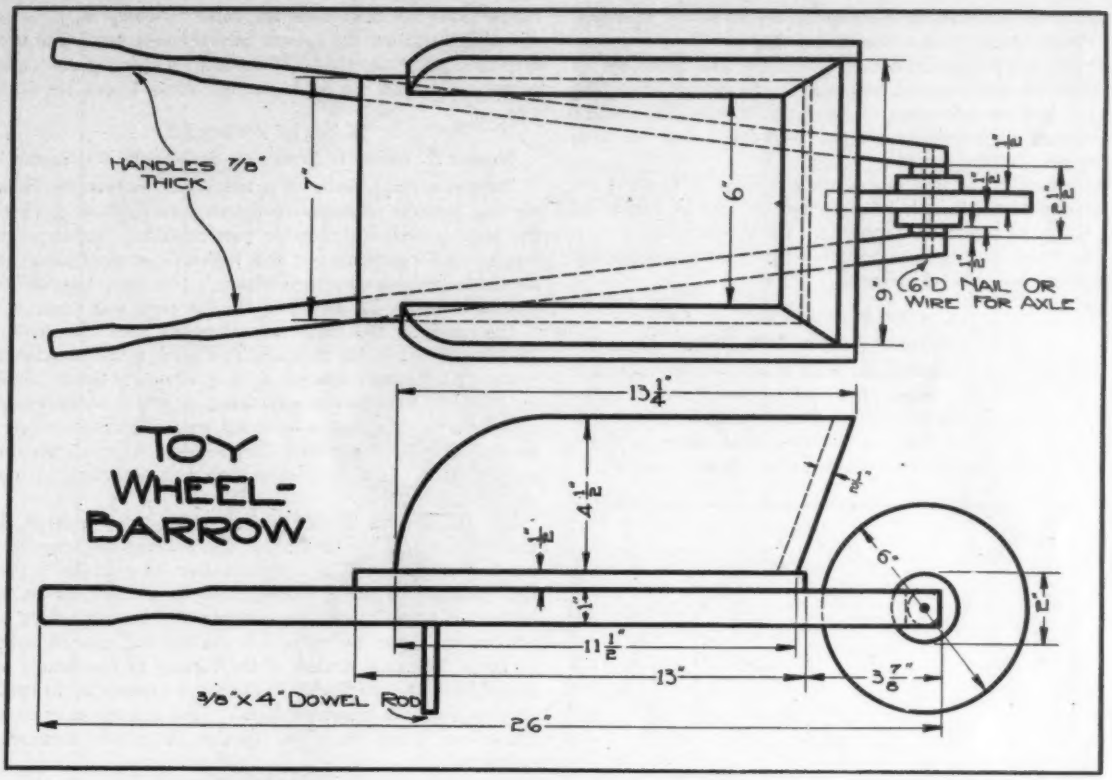
Frank S. Hale, C. M. Schwab Vocational School, Homestead, Pennsylvania

The wheel puller is an interesting project for a school shop, and also a very useful one. The body is of machine steel. The project embodies some useful operations in outside tapering, boring, and inside chasing. The small end is drilled and tapped in the lathe, using a ¾-in. tap. The milling machine comes into use for milling the hexagon on the end. The screw is of tool steel and is tempered. The threads are chased, and the head is standard cap-screw size. Its head also may be cut on the milling machine. The bore and number of threads per inch in the large end can be changed for different makes of cars.



SUBMITTED BY LESLIE J. MILLER, SUPERVISOR INDUSTRIAL ARTS, ROCK SPRINGS, WYOMING





TOY WHEELBARROW

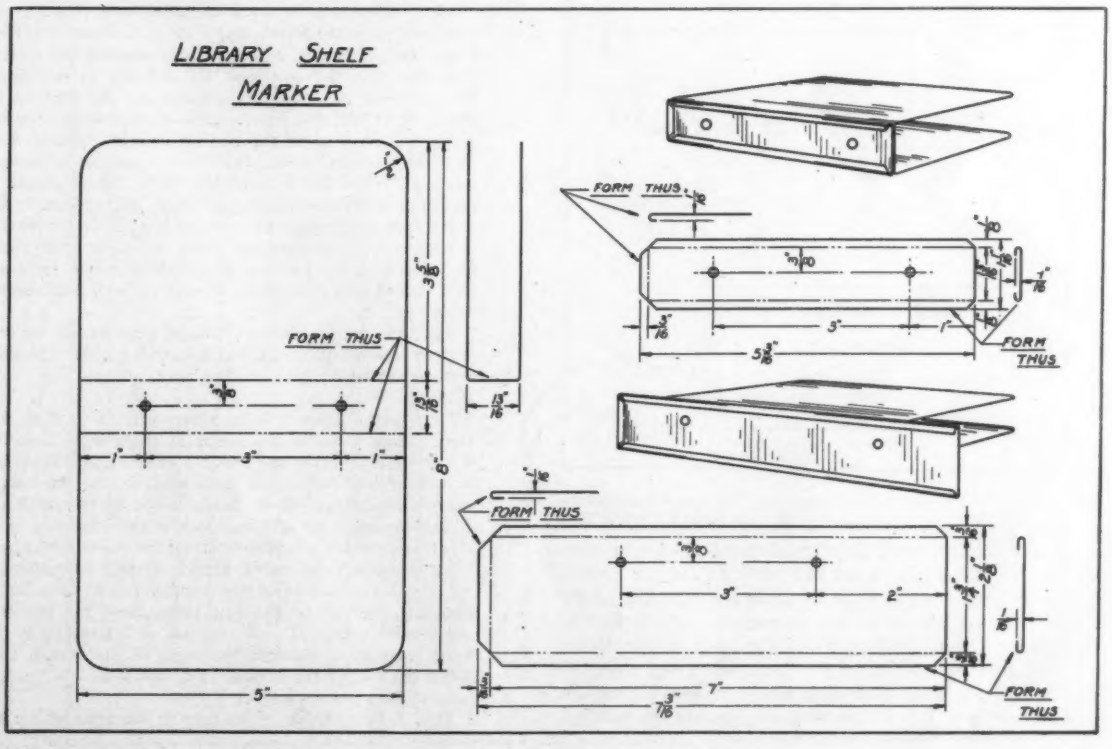
Glenn H. Osborne, High School, Ottumwa, Iowa

Toys of any kind, always are welcome projects in the school shop. The toy wheelbarrow illustrated herewith can easily be made by a junior-high-school boy. A small packing box will furnish sufficient lumber to make this article and thus its cost will be very small. After finishing, it should be given several coats of a bright-colored paint.

LIBRARY SHELF MARKERS

W. A. De Vette, Wilson Junior High School, Erie, Pennsylvania

The library shelf markers described in this article, were



designed in two sizes at the request of the school librarian. They were made in the school metal shop.

Their construction embodies operations and principles of construction which should be taught in the general shop. The project has the advantage of being useful school equipment when completed, and the material used for it does not have to be paid by the student.

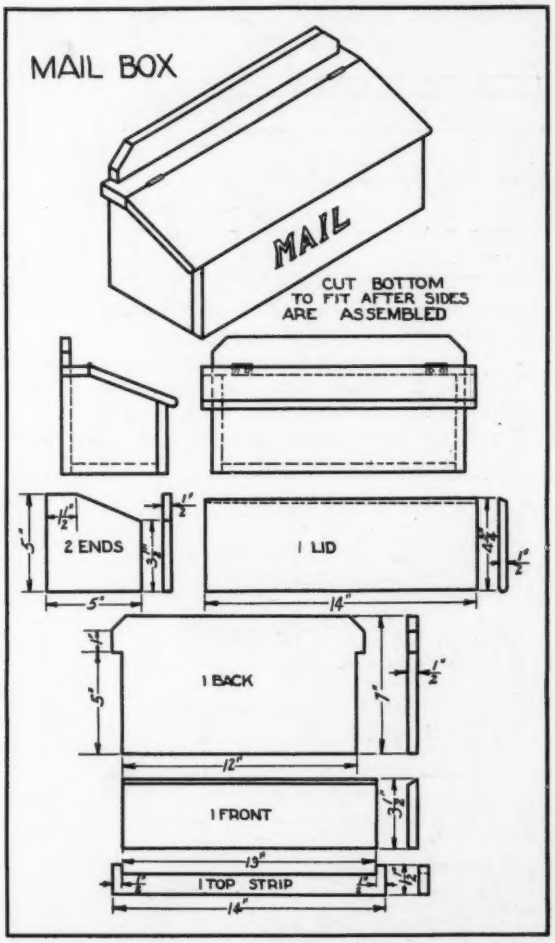
As shown in the illustration, the parts of the markers are to be riveted together, but the rivet holes may be omitted at the option of the instructor and the parts soldered.

The finish may be applied either by brushing or dipping, depending upon the equipment.

A SIMPLE MAIL BOX

Paul C. Hoopes, Roselle, New Jersey

The mail box illustrated herewith is simply constructed. It may be made of almost any kind of wood and is nailed together. It is designed to be used under a shelter, such as a porch or storm vestibule, as the open joint where the lid is hinged makes the box undesirable in an exposed position.



Procedure: Cut out two pieces for the ends having the grain run from back to front of the box. Be sure to tack both pieces together when shaping so that both will be alike. Next cut out the back, laying out the cuts for the ends to fit into by placing each end in its place and marking around it. When these three pieces are shaped they are tacked together, using 1¼-in. finishing nails. The front is next tacked on. Allow plenty of width in the front piece and plane the bevel on the top edge *after* it is nailed in place. Next, the bottom is cut out. This is cut to fit the opening and as slight variations as to exact sizes are liable to creep in, it is not advisable to cut out the bottom until the side, front, and back have been nailed together. The top strip is then cut and nailed in place and then the lid is put on. Brass hinges should be used.

A DOOR KNOCKER

Stephen J. Smith, High School, Snohomish, Washington

There is a real scarcity of practical and inexpensive metal-working projects adaptable to the shop facilities of the average high school. Teachers of patternmaking, foundry, and forging, are constantly on the lookout for interesting and teachable projects for their classes. The door knocker described herewith, is offered to fill this particular need.

The initial or monogram superimposed upon the shield is the central idea of the design of this project and likewise the center of the pupil's interest. It is a seemingly natural desire for a boy to want to carve his name or initial somewhere, or anywhere. In this project he is not only encouraged to carve his initial but is so guided that he does it artistically and systematically with the proper tools and according to trade practices.

The building up of this project is decidedly practical, because it unites the work of four departments successively. It can be best designed as a definite part of a student's practical drawing. Then the design can be worked out in the pattern shop where the fundamentals of patternmaking are emphasized. Next, the pattern is molded and poured in iron or brass. The final project is the forging of the handle and shaping it to fit the shield. If the shops attempting to handle this project do not have a foundry, the castings may be obtained for a few cents per knocker from any commercial foundry.

Student Contract

Design

Lay out the shield design of such size and proportions as to fit the needs of the particular door for which it may be intended. The suggested design fits standard doors. Use and old-English letter for the initial, and make it sufficiently large to be readily recognized, and to be in proportion to the shield.

Pattern

Select 3/16-in. plywood with no defects. Transfer the shield design to the plywood and cut out, allowing 1/16-in. draft. The draft not only facilitates drawing the pattern from the sand, but improves the richness of the design. Glue a piece of battleship linoleum to the face of the shield. After the glue has set transfer the initial or monogram and carve away the surplus linoleum with a ¼-in. or 5/16-in. round carving tool. It is important to have no sharp edges at the base of the letter. These should be curved as illustrated, both to facilitate pouring and to give a more finished appearance. With this done, the pattern is ready for the shaping and gluing on of the striker plate and boss for the knocker handle. The whole pattern is then sanded and given three or four coats of black shellac.

Foundry

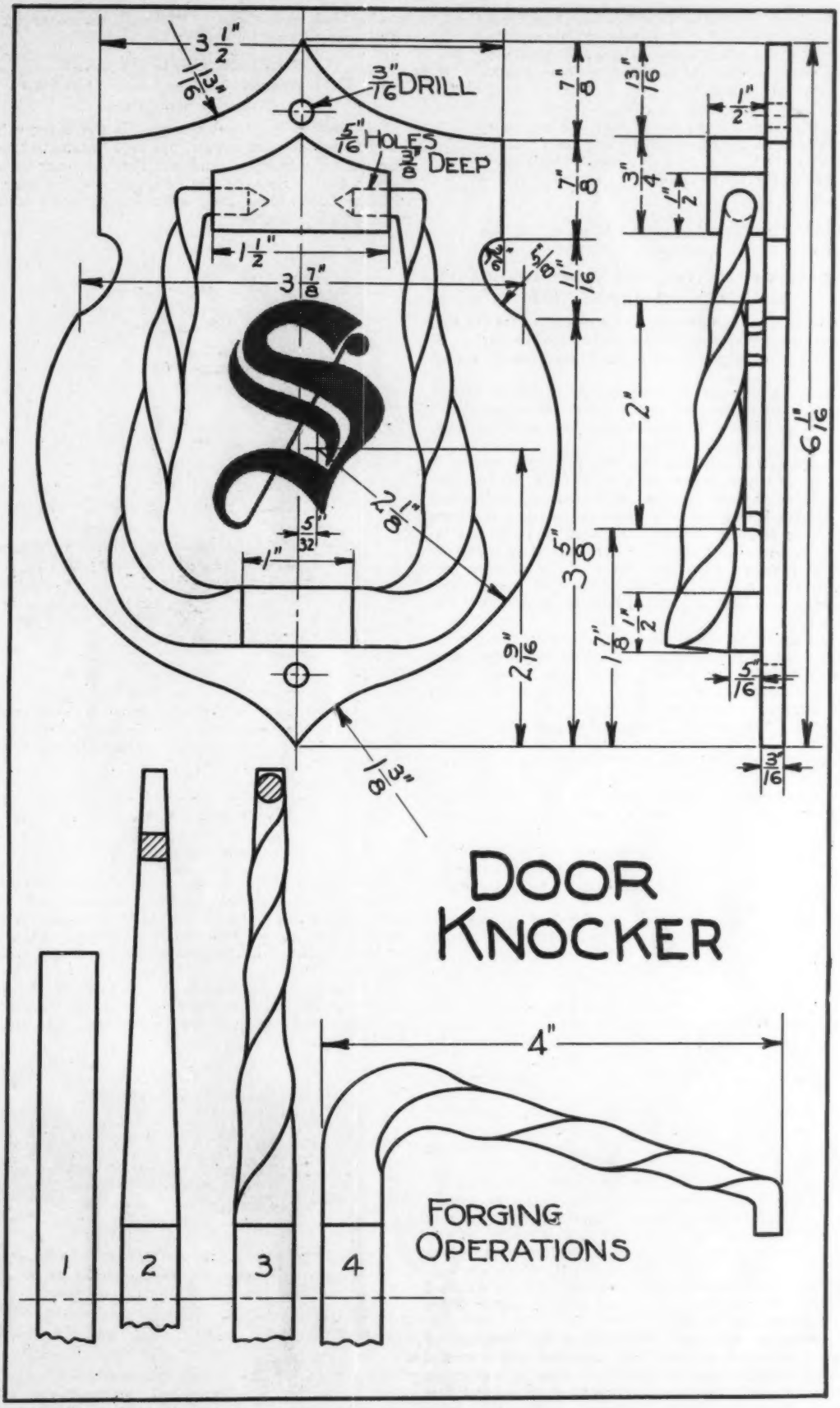
Place the pattern in the sand and pour in iron or brass if shop facilities permit. Clean the casting after it has been removed from the sand, with a wire buffer.

Forging

Draw out a piece of ⅜-in. square black iron stock 6 in. long. Leave 1 in. in the center at stock size. Taper the ends to ¼ in. square and round a piece of this ⅜ in. long at each end. Then get the stock white-hot at the heaviest portion and shade off to nearly black at the small end. Clamp the stock upright in a vise at the beginning of the taper and twist one revolution from the small tapered end, using a smooth flat-jawed wrench. Repeat this operation for the opposite side of the handle, *except* twist in the opposite direction to the first twist. Bend the handle to shape with a pair of tongs instead of hammering it. Too much hammering damages the edges of the twisted taper. Bend the tips of the handle to fit the boss.

Assembling

Drill 5/16-in. holes, ⅜ in. deep in the sides of the boss


3 1/2"
1/16 13/16"
3/16" DRILL
5/16" HOLES 3/8" DEEP
1 1/2"
3 7/8"
7/8"
7/8"
11/16"
5/8"
2"
6 1/16"
3 5/8"
2 9/16"
1 7/8"
1/2"
1/2"
3/4"
1/2"
5/16"
1"
5/32"
2 1/8"
1/8 3/16"
DOOR KNOCKER
4"
FORGING OPERATIONS
1
2
3
4

to take the tips of the handle when they have been finally bent into place. Also drill 3/16-in. holes as illustrated for mounting. Heat the handle along one side and strike with a wooden mallet to close the handle to the proper width to hang evenly in the boss.

Finishing

Buff the casting and forged handle until it is bright and clean. Paint it a dead black. After this coat has dried, the high spots may be touched up with copper-bronze lacquer, using a nearly dry brush which has been lightly dipped into the lacquer solution.

Mounting

The knocker may then be fastened in place with two 5/8-in. No. 4 or 5 r.h. blued screws.

COOPERATIVE PART-TIME EDUCATION ADVOCATED AS APPRENTICESHIP SYSTEM

Cooperative part-time education as a substitute for the old-time apprenticeship system, has been advocated by Mr. C. E. Rakestraw, regional agent of the Federal Board for Vocational Education.

The great advantage of cooperative part-time classes according to Mr. Rakestraw, is that a boy can secure simultaneously the technical knowledge that goes with his trade and can get his training in industry.

Mr. Rakestraw points out that the present tendency is to keep boys in school longer, and a strong effort has been put forth to induce young men to enter into apprenticeships. Since 1917, various types of schools or courses have been developed for carrying on organized work in trade and industrial education, the cooperative part-time class being the type which has met with much favor among workers, employers, and school officials in all sections of the country. Such courses have been established both in trade schools and in high schools.

In the opinion of Mr. Rakestraw, the cooperative part-time system tends to keep a boy in school longer and gives him an opportunity for a real contact with industry while still going to school. The student is able to apply on the job the concrete matter taught in the school.

The great advantage of a cooperative part-time class is that a boy can secure simultaneously the technical knowledge that goes with his trade, and can get his training in industry. By this method, the student is made a better tradesman and is able to earn money while learning. At the same time, he receives more technical and related information than would be possible under the former apprenticeship system.

Cooperative part-time training has a number of advantages not found in unit-trade work. In many cases, boys complete a unit-trade course without ever following the trade for which they have been trained.

In cooperative part-time training, the boy is employed in the trade for which he has been trained. If, for any reason, he is unsuited for the trade, or if he dislikes the work, he leaves the course voluntarily, and there is no further cost for instruction, or waste of his or the instructor's time.

No cooperative boy remains in trade classes for the purpose of experimenting in order to shirk some academic study. In almost every instance, the cooperative boy is absorbed by the company where he received his training.

According to Mr. Rakestraw, cooperative part-time work is, on the whole, far more efficient than the usual unit-trade class, because the school instructor himself must, of necessity, be competent and up-to-date in that part of the trade which he teaches. His work comes under the constant observation of industrial men who know the essentials of the trade.

In the unit-trade course, the instructor must keep his knowledge up-to-date. The cooperative instructor cannot carry on his work unless he knows his job and keeps up with present-day practices. A trade class not connected in any way with industry is not likely to be as efficient as one which is tied up to industry. The school instructor of the cooperative part-time class finds himself compelled to know standard practices in the industry, and to use subject matter which directly functions on the job.

In connection with the establishment and conduct of cooperative part-time courses, it is suggested that a careful analysis be made of the trades for which training is given, in order to reveal what is required in the way of related technical knowledge, trade skill, related science, mathematics, trade drawing, and trade theory. The craft committee should be called upon to assist in making the analysis.

THE ELECTRIFIED VANITY

R. M. Hammes, Abraham Lincoln High School,
Council Bluffs, Iowa

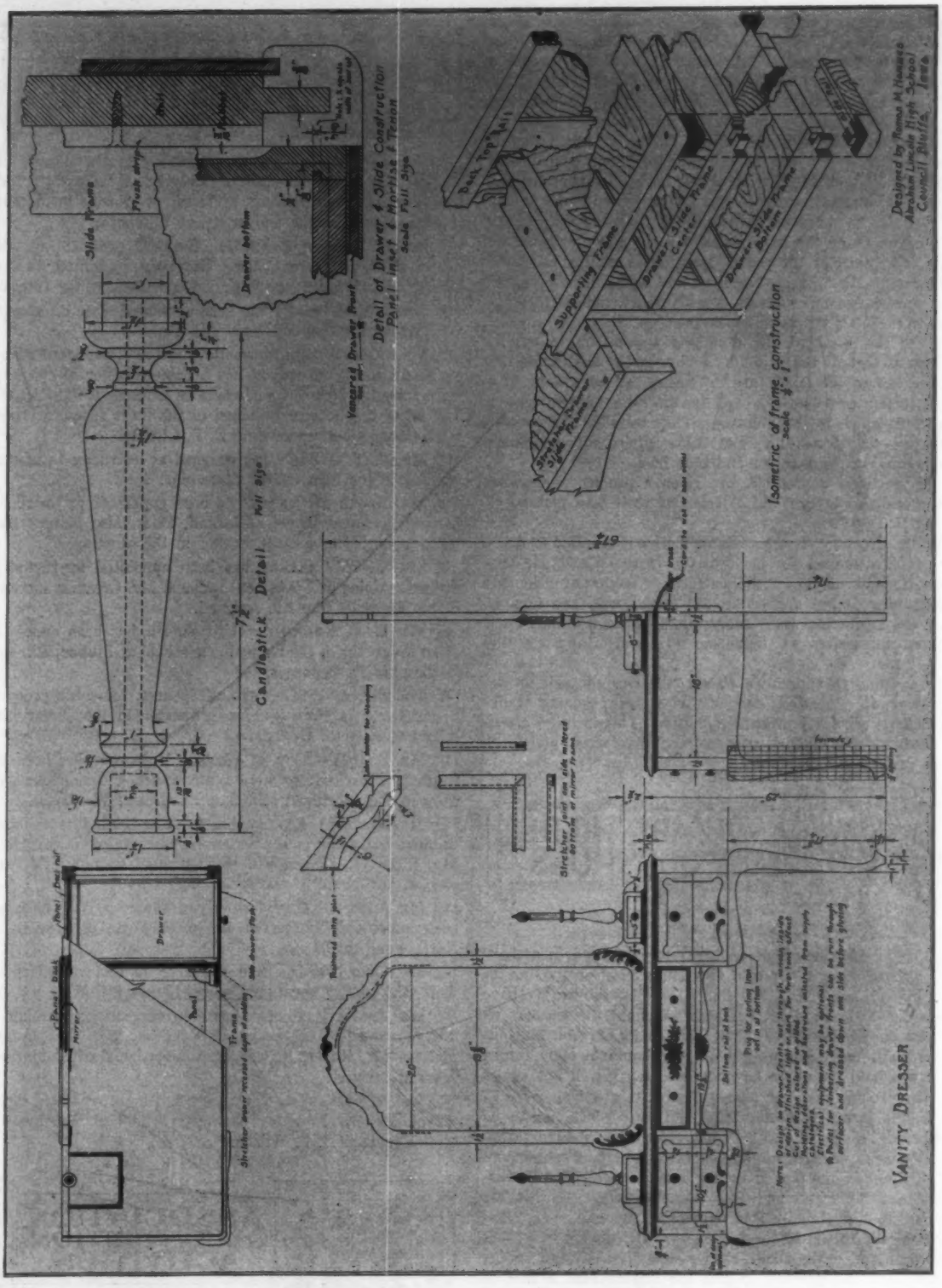
The problem presented herewith is the outgrowth of a study to secure some design capable of adaptation to more than one piece of home furniture. The idea being to have all boys in the course using the design receive the same points of instruction, without being obliged to construct exactly the same piece of furniture.

VANITY DRESSING TABLE

Minor parts of the design can be changed to conform to periods to be matched, or the decoration and moldings simplified or elaborated to be in taste with the type of piece desired. This can be done without changing the construction or general plan. The construction used is shown in detail in the illustration.

A problem of this kind is just as easily made as one of poorer design, and it is something of which the maker may be proud. Moldings may now be procured from any supply house in most any form desired.

DRESSING TABLE DESIGN APPLIED TO WRITING TABLE


Detail of Drawer & Slide Construction
Panel inset & Mortise & Tenon
Isometric of frame construction
Candlestick Detail
Designed by Ronus M. Hansen
Arnold Linde High School
Council Bluffs, Iowa.
VANITY DRESSER

TRAINING APPRENTICES TO DO THE JOB

R. D. Fleming, State Education Department, Albany, New York

Theory plus practice has been followed in a unique system of apprentice training which has been carried out in the day-school classes for apprentice training at Syracuse, N. Y. The work was started with one class in bricklaying and one in painting and decorating. The work has grown so that classes in carpentry, plumbing, stonecutting, machine-shop practice, electricity, factory maintenance, and meter testing have been added.

The apprentices attend school four hours each week on the employer's time. Each class spends two hours a week in school at practical work, with the remainder of the time devoted to subjects related to the trade, such as science, drawing, and trade mathematics.

In the practical instruction, the young apprentice is given a project to do. The young bricklayer, for example, builds an entrance to the school office, laid the wall, constructed a Roman archway, and built a brick seat or bench. The apprentices of the stonecutting class cut the stone for the arch. The project also included work for the electricians', carpenters', and pointers' classes of the school. A project which was of special interest was one in ceiling decoration, with Italian marble walls and woodwork, carried on by the painting and decorating classes. In order to give all the apprentices a part in the project, the instructor gave to the first-year apprentices the task of removing the paper from a room and preparing the walls. The work of the group consisted in sandpapering the ceiling and walls, mixing the colors, and laying out the panels. The finished room, with its marble walls and harmonious woodwork, has a beautiful appearance.

While the work of the plumbing apprentices is not as artistic as that of the painters, it is none the less important. In one end of the laboratory is located the framework of a small section of a house, where the first-year apprentices are taught to rough in the plumbing. They installed the melting furnaces, sink waste line and other equipment, and were taught how to make solder and beat lead.

The electrical apprentices are given a project of drawing a floor plan of houses and of selecting their own method of wiring it.

In the carpentry classes, each apprentice is required to make a pair of sawhorses for his own use in the school. He lays out and cuts bridging for the platform or section of a floor, is taught how to put a shoe around a platform, and how to place the layout for studs, doorway, and window frame. Each apprentice is required to make and set one door and one window frame.

In addition to apprentice classes, the city through its department of education, conducts classes in evening trade-extension work for journeymen workers. This includes extension work for plumbers, painters and decorators, and blueprint reading for carpenters.

NOW, ARE THERE ANY QUESTIONS?

ALUMINUM ARROWS

930. Q.: A number of us here are interested in archery and we are making our own aluminum alloy arrows out of .015 by 9/32-in. O.D. X Random Alcoa 51st tubing. We have devised a little hand fletcher that will hold the feathers on the metal. We use the Dupont Household Cement which is waterproof. What can we put on the aluminum alloy tubing that will hold the glue? Lacquer does fairly well but comes off after some time. The glue will stick to anything.—*E.J.V.*

A.: It is my suggestion that the ends which are to be feathered, be dipped into a boiling solution of sodium carbonate (washing soda) made by dissolving a heaping tablespoonful of the soda in a pint of boiling water. The alkali will readily attack the metal and etch it sufficiently to enable the cement to take hold. After immersing the end of the rod *momentarily* in the solution, withdraw and plunge into vinegar to neutralize the alkali, after which rinse in clean boiling water. Dry and proceed to give the treated area a coat of cement. Dry again and then attach the feathers, recoating with the cement.

If this, too, should fail, then treat with both alkali and acid as before. Dry and then coat wth a well-brushed-out application of air drying, lacquer base, metal primer. Let dry hard overnight, or with the aid of gentle heat for a few minutes, after which attach the feathers as before.—*Ralph G. Waring.*

AMONG the INDUSTRIAL ARTS TEACHERS

¶ Mr. Russell W. Fowler, formerly in the department of practical mechanics, Purdue University, LaFayette, Ind., has been appointed assistant professor of drawing in mechanical engineering at the University of Wisconsin.

¶ Dr. W. Carson Ryan, Jr., formerly professor of education at Swarthmore College, has been appointed director in the Indian Service for the U. S. Department of the Interior.

¶ Mr. J. V. Ankeney has been appointed state director of vocational education for West Virginia.

¶ Mr. H. H. Wilbur, formerly director of the trade school at Torrington, Connecticut, has become director of the state trade school at New Britain, where he succeeds E .D. Packard. The latter has become principal of the trade school at Hartford, Connecticut, succeeding E. P. Chester.

¶ Mr. R. T. Othmer has resigned as instructor in manual training in the high school, Muscatine, Iowa.

¶ Mr. Roger M. Regan has been appointed as instructor in the vocational school at Lowell, Mass. Mr. Hanson has been appointed as a shop teacher in the same school.

¶ Mr. C. N. Creamer has been appointed instructor in manual training at Covington, Indiana. Mr. Creamer succeeds Edgar Richards who has resigned.

¶ Mr. H. O. Kruzan, of Urbana, Ill., has been appointed as an instructor in the manual-arts school at Moline, Ill., succeeding Mr. H. O. Jaeger.

¶ Mr. Clarence McClurg, of Spencer, Iowa, has accepted a position as manual-training instructor in the junior high school at Atlanta, Georgia.

¶ Mr. F. I. Wallace, of Viroqua, Wisconsin, has been appointed as instructor in auto mechanics and machine-shop work in the vocational school at La Crosse, Wisconsin.

¶ Mr. Herbert Kelley has been appointed as manual-training instructor in the junior high school at Salem, Ohio. Mr. Karl W. Sander will teach manual training and commercial arithmetic in the senior high school.

¶ Mr. Adolph Klatt, formerly of Shawano, Wisconsin, has been appointed director of the manual-arts department at North Fond du Lac.

¶ Mr. Fred Just has been elected as instructor in machine-shop work at the vocational school, Janesville, Wis.

¶ Mr. Ralph Y. Cooper has been appointed a member of the vocational-school board of Kenosha, Wis. Mr. Cooper replaces Mr. Robert S. Cooper, who resigned after fourteen years of service.

¶ Mr. R. McKinley Cleveland has been appointed director of the Beechwoods Vocational School at Beechwoods, Pa., to succeed H. F. Wilson.

ASSOCIATION & CONVENTION ACTIVITIES

AMERICAN VOCATIONAL ASSOCIATION WILL MEET IN MILWAUKEE

The American Vocational Association will hold its annual meeting December 10–13, at Milwaukee, Wis. The headquarters will be in the Hotel Schroeder.

(Continued on Page 24a)

"The STRONGEST Wood Handled Screw Driver"

Stanley No. 1001
Screw Driver
Seven Sizes: 3", 4", 5", 6", 8", 10" and 12" blades.

NOT an idle boast. A fact, proved by everyday use in thousands of garages and industrial plants where extreme demands are made on the strength and temper of screw drivers.

It is a high quality tool from tip to leather cap. Handle is made of young, straight grained hickory. The end of the handle is pre-shrunk to insure that bar and ferrule remain tight. Handle is capped with leather washers to withstand abusive pounding.

THE blade is forged from one piece of high grade steel and oil tempered its entire length. The tang of the blade is forced into the handle under pressure and positively locked by two heavy wings.

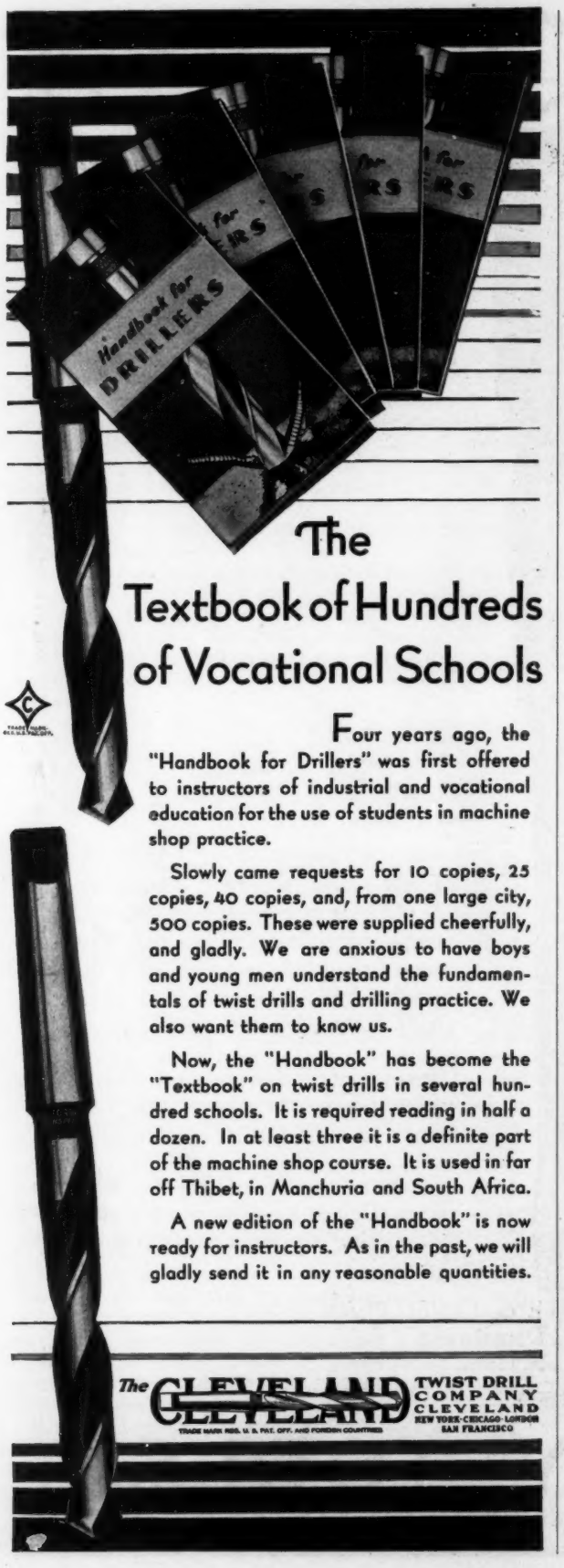
Tips are accurately ground with a long taper so they have little tendency to turn out of a screw slot.

Specifying the STANLEY No. 1001 Screw Driver for your shop means eliminating expensive replacements.

THE STANLEY RULE & LEVEL PLANT
Educational Department
New Britain, Conn.

STANLEY TOOLS

Stanley Equipment is Standard Equipment


Handbook for DRILLERS
The Textbook of Hundreds of Vocational Schools
Four years ago, the "Handbook for Drillers" was first offered to instructors of industrial and vocational education for the use of students in machine shop practice.
Slowly came requests for 10 copies, 25 copies, 40 copies, and, from one large city, 500 copies. These were supplied cheerfully, and gladly. We are anxious to have boys and young men understand the fundamentals of twist drills and drilling practice. We also want them to know us.
Now, the "Handbook" has become the "Textbook" on twist drills in several hundred schools. It is required reading in half a dozen. In at least three it is a definite part of the machine shop course. It is used in far off Thibet, in Manchuria and South Africa.
A new edition of the "Handbook" is now ready for instructors. As in the past, we will gladly send it in any reasonable quantities.
The CLEVELAND TWIST DRILL COMPANY CLEVELAND
NEW YORK-CHICAGO-LONDON SAN FRANCISCO

(Continued from Page 448)

The local committee on arrangements has announced the tentative program for the meeting. The first general session will be held in the auditorium of the Milwaukee Vocational School and the other sessions will take place in the Crystal Ballroom of the Hotel Schroeder.

The general topic for the division of industrial education will be "Vocational Education as a Constructive Factor in Industry." Group one will take up examples of vocational training in type industries; group two, examples of training in skilled and unskilled work; group three, training for junior technical positions in industry. Other groups will discuss examples of training for specialized operations, results of apprentice training, and the foreman in industry.

The division of industrial arts will take up the topic, "Good Practice in School Use of the General Shop," giving special attention to implications in industrial-arts development, standards and tests in industrial-arts teaching.

There will be a number of sectional meetings for teachers of home economics, vocational rehabilitation, agriculture, part-time education, vocational guidance, commercial education, teacher training, printing, and decorating instructors.

The "Ship" program, which will occupy the full time of Friday afternoon, December 12, will be held in the main arena of the auditorium.

Complete information regarding the meetings and the speakers may be obtained from Mr. Paul W. Chapman, president of the association, or from Mr. R. L. Cooley, chairman of the local committee on arrangements for the meeting.

STOUT PRINTING TEACHERS HOLD PROFITABLE MEETINGS

The Stout Printing Teachers' Association held a number of interesting and helpful meetings during the past summer at Stout Institute, Menomonie, Wisconsin. The meetings were attended by 55 men, representing seventeen states of the Union.

The association has been placed on a sound financial basis. The life membership has been set at $1.

At the business session, the association elected the following officers for the year 1930–31: President, Mr. Carl Gernetsky, Council Bluffs, Iowa; vice-president, Mr. Al Poellinger, Neenah, Wis.; secretary-treasurer, Mr. L. A. Petersen, Green Bay, Wis.

The association which is open to printing teachers trained at Stout, is intended to provide a medium for acquaintance and contact among Stout graduates who teach printing, and to set up definite objectives for printing instruction in various types of schools. It sets up standard practices, coöperates with superintendents and principals, supports national and state agencies representing this field of work, and promotes a coöperative spirit among the members for united efforts in the printing field.

The association sponsors a quarterly publication *The Stout Printing Bulletin*, which is prepared, edited, and printed at Stout Institute.

WASHINGTON INDUSTRIAL TEACHERS TO MEET IN SEATTLE

The industrial-education division of the Washington Education will hold its annual meeting October 23 to 24, at Seattle, Wash. Mr. Ernest Osgood, of Seattle, Wash., chairman of the committee on arrangements, is completing plans for the meeting.

Information about the meeting may be obtained from Mr. Osgood, or from Mr. R. T. Blaylock, secretary of the association, Seattle, Wash.

NEVADA VOCATIONAL TEACHERS HOLD SEVENTH CONFERENCE

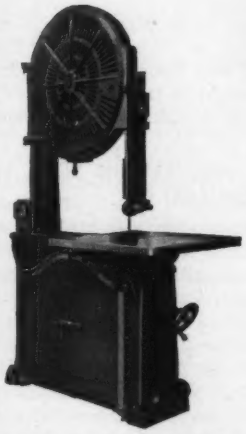
The seventh annual Nevada Vocational Conference was held recently at Glenbrook, Lake Tahoe. The meeting was in three

(Continued on Page 26a)

Photograph shows the Boys' Technical High School in Milwaukee.

YATES-AMERICAN WOODWORKING MACHINES SELECTED for BOYS' TECHNICAL HIGH SCHOOL,

MILWAUKEE, WISCONSIN



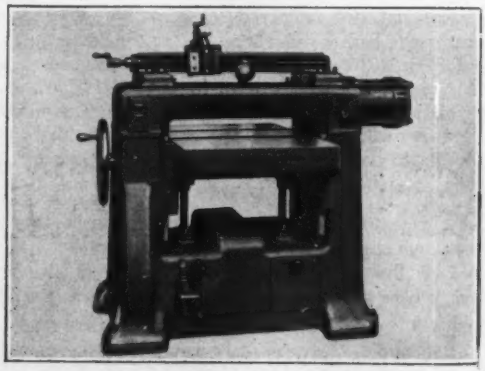
The Yates-American Y-36 Band Saw installed in the Boys' Technical High School — the most durable, efficient machine of its type manufactured. Note saw blade is entirely enclosed for safety.

Yates-American woodworking machines scored again through the installation of the machines here illustrated at the Boys' Technical High School in Milwaukee, Wisconsin. Yates-American "Leads the field" in high quality, long-life, safe, woodworking machines. Being regular full size, the same as used industrially, Yates-American machines make the finest possible installation where a real training program is intended for the student. The selection of correct machine equipment is being given more consideration each year and where these selections are based on quality and machine efficiency, Yates-American is the invariable choice.

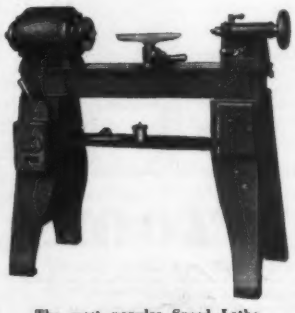
YATES-AMERICAN MACHINE CO.

Vocational Machinery Division

BELOIT, WISCONSIN



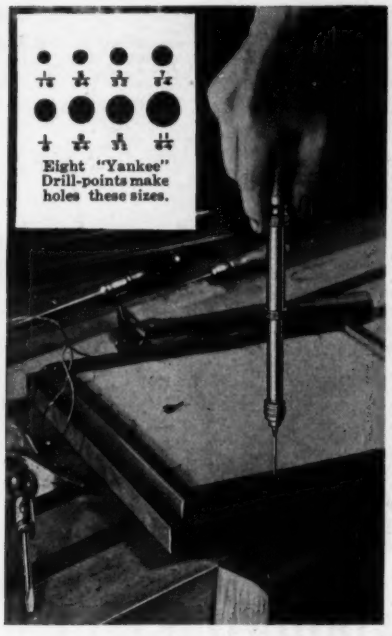
The B-4 Single Surfacer also installed in the above institution. A high class Yates-American surfacer with every operating part enclosed.



The most popular Speed Lathe for school use—the Yates-American No. 12 — was also chosen.

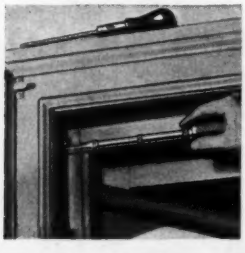
OTHER YATES-AMERICAN SCHOOL EQUIPMENT:

Circular Saws	Sanders
Band Saws	Surfacers
Mortisers and	Moulders
Borers	Heads and
Lathes	Knives
Shapers	Supplies and
Jointers	Accessories
Tenoners	of all kinds.



First, make a hole for the screw!

Use the "Yankee" Automatic Push Drill, as illustrated. You operate it simply by pushing on the handle. That is the tool the mechanic uses before he drives a screw . . . to make the right size hole for the screw and save splitting the wood.



No. 41.—Used along with "Yankee" Spiral Screw-driver, by mechanics everywhere. Price, $2.60.

No. 44.—Adjustable Tension regulates pressure to suit kind of wood, size of drill. Price, $3.15.

Mechanics will tell you "Yankee" toolmaking can't be copied . . . look for the name "Yankee" when you buy a push drill.

"YANKEE" TOOLS

MAKE BETTER MECHANICS

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

You may send "Yankee" Tool Book (offered in Industrial Arts) —Showing Spiral and Ratchet Screw-drivers, Automatic Push Drills, Ratchet Braces, Socket Bit-Extensions, Ratchet and Plain Breast and Hand Drills, Automatic Chain and Bench Drills, Ratchet Tap Wrenches, Continuous-Work Swivel Vises, Plain Screw-drivers, Etc. *(Please clip and write name and address in margin below)*

(Continued from Page 24a)

sections, trade and industry, home economics, and agriculture. The trade-and-industry section was in charge of Mr. B. W. Johnson of Los Angeles, Calif.; the home-economics section was led by Miss Maude Williamson, of Port Collins, Colo.; and the agricultural section was presided over by Mr. H. E. Lattig, of the University of Idaho.

Considerable attention was given in each section to the laying out of courses of study. The trade-and-industry section, through its special committees, conducted an analysis of a particular job, blocking it for teaching units; the agricultural section discussed aims and objectives of vocational education in agriculture as reported by the national committee. Other subjects taken up were tests for trade training, vocational guidance, placement and follow-up, and problems of coördination.

The home-economics group took up the revision of the course of study, giving particular attention to methods of teaching, home projects, methods of teaching child development, laboratory management, club work, publicity, and programs of work for home-economics departments.

WISCONSIN INDUSTRIAL-ARTS TEACHERS TO HOLD MEETING AT MILWAUKEE

The Wisconsin Industrial-Arts Teachers will hold an interesting meeting on October 30, at Milwaukee, Wisconsin. Mr. E. S. Lamoreaux, president of the association, will preside at the sessions.

Mr. George F. Kull, secretary of the Merchants and Manufacturers of Wisconsin, will talk on "What Industry Expects of the High-School Graduate with Four Years of Industrial Art." Mr. Frank O. Holt, registrar of the University of Wisconsin, will discuss "Vocational Guidance and Counseling in the Industrial Arts."

ILLINOIS VOCATIONAL ASSOCIATION WILL MEET IN CHICAGO

The Illinois Vocational Association will hold its annual meeting in the Hotel Sherman, at Chicago, Ill., November 7 to 8. Mr. William J. Bogan, superintendent of schools of Chicago, president of the association, will be in direct charge of the meeting.

Although the plans for the meeting are incomplete at the present time, it is announced that the work of preparing the program is going forward. There will be general meetings on Friday afternoon and Saturday morning, with sectional meetings on Friday morning and Saturday afternoon. The annual banquet session will take place on Friday evening. A number of sectional meetings for various groups of instructors have been arranged, including commercial education, art education, industrial education, part-time education, personnel and guidance, printing, home economics, and agriculture.

There will be an exhibit of commercial products of interest to vocational and industrial teachers. Mr. L. Day Perry, Chicago, Ill., is in direct charge of the exhibit.

Information concerning the meetings and the speakers may be obtained from Mr. Bogan, or from Mr. U. G. Willis, secretary of the association, 250 East 111th Street, Chicago. Mr. L. D. Perry will be glad to give information about the exhibit.

MINNESOTA VOCATIONAL ASSOCIATION TO HOLD MEETING

The Minnesota Vocational Association will hold its annual dinner and business meeting on Friday, October 31, at the Y.W.C.A. Building, 12th and Nicollet Streets, Minneapolis. There will be a program of interesting speakers and election of officers.

MINNESOTA INDUSTRIAL-EDUCATION ASSOCIATION TO MEET AT MINNEAPOLIS

The annual meeting of the Minnesota Industrial Education Association will be held October 31, at Minneapolis, in

(Continued on Page 29a)

(Continued from Page 26a)

connection with the meeting of the Minnesota Education Association.

The section will hold a joint meeting with the sections of agriculture, vocational, and home economics on Friday morning, with Mr. R. W. Selvidge as the principal speaker. The afternoon session will be devoted to round-table meetings at the Dunwoody Institute.

At the round-table session for supervisors of teacher training, Mr. V. C. Fryklund, of the University of Minnesota, will act as chairman. The speakers are Mr. R. C. Craigo, of Minneapolis, Mr. D. Schweickard, of Minneapolis, and Mr. R. W. Selvidge of the University of Missouri.

At the round-table session on sheet-metal work, Mr. A. J. Kise, St. Paul, will act as chairman. Mr. C. B. Diers, Duluth, will speak on "Sheet Metal in the Junior High School"; Mr. R. W. Wagner, of St. Paul, will discuss "Model Boats of Metal"; Mr. Pierson, Dunwoody Institute, will lead a discussion of shop problems, while Mr. G. M. Caviness, of Minneapolis, will take up the subject of "Related Information."

At the round-table session on electricity, Mr. E. H. Fray, of Duluth, will act as chairman. Mr. V. Jorgenson, Virginia, will discuss "electricity as a High-School Subject"; Mr. C. H. Reeves, of Hibbing, will talk on, "Standardization of Aims and Objectives in Junior High School Work"; Mr. Hagen Carleton, of Duluth, will discuss "Should Junior-High-School Boys be Required to do Work Correctly and up to Vocational Standards"; Mr. H. F. Hinton, Minneapolis, will speak on "Reduction of Losses and the Wear and Tear of Equipment."

At the visual-education session, Mr. L. A. Williams, St. Cloud, will act as chairman. Miss Ella Probst, Minneapolis, will discuss "Visual Aids," and Mr. P. H. Verner, of the Eastman Kodak Company, will talk on "Administrative Phases of the Use of Classroom Films."

At the auto-mechanics session, Mr. R. C. Miller, St. Cloud, will act as chairman. Mr. G. O. Tollerud, of Austin, will discuss "Advantage of Stationary Motors"; Mr. W. H. Fulton, Virginia, will take up "Equipment for Good Shop Instruction; and Mr. J. F. Bartlett, Duluth, will discuss "Shop Problems."

At the home- and farm-mechanics session, Mr. J. Grant Dent will act as chairman. Mr. C. H. Johnson, St. Paul, will discuss "A Project in Sheet Metal"; Mr. C. L. Berggren, of the University of Minnesota, will talk on "Saw Sharpening"; and Mr. L. H. Harnsberger, St. Paul, will discuss "Aeronautics in the High School."

At the printing session, Mr. Olson, Minneapolis will be chairman. Mr. Porter, of Dunwoody Institute, Minneapolis, and Mr. Leslie, of the Leslie Paper Company, are the speakers.

At the woodwork session, Mr. B. C. Fowler, of Ortonville, will act as chairman. Mr. F. J. Rehor, East Grand Forks, will discuss "Job Sheets and the State Syllabus"; Mr. C. C. Clapper, Litchfield, will talk on "Lower Grade Projects for Woodworking"; and a representative of the Thurston Company, of Anoka, Minn., will give a demonstration of upholstering.

At the drawing session, Mr. A. E. Johnson, St. Paul, will act as chairman. Mr. H. H. Sitzer will discuss "Free-Hand Drawing in the Mechanical-Drawing Course"; Mr. L. F. Knowles, St. Paul, will take up the subject of drawing courses in the state; Mr. W. J. Jelliffe, Waseca, will discuss "Content of Mechanical Drawing Courses for First-Year High School."

At the machine-shop session, Mr. R. O. Berg, St. Paul, will be chairman. Mr. John Mooney, St. Paul, will discuss "Present-day Standards of Accuracy"; Mr. G. M. Brace, St. Paul, will talk on "Methods in Handling Large Classes"; and Mr. Huna will give a demonstration of oxyacetylene welding.

WHAT features do your boys need in a hammer? What will help their unskilled hands do a better job, in less time, with less spoiled work? That's what counts! Not what we think they ought to have.

So Plumb Tool designers get more ideas from users than they do in the factory: Working in school shops with instructors, out on jobs with carpenters and mechanics; making suggestions; getting criticisms; designing tools in the only practical laboratory—that of actual use.

Over a period of years this method has developed many improvements in design . . . changes that have brought Plumb Tools to a high peak of efficiency.

No wonder the expert picks a Plumb Nail Hammer: With its broad face for greater accuracy; with its short neck for better balance; with the sharp bend of its claws which gives powerful leverage; with its vise-like grip that pulls the slimmest headless brad; with its balance that makes it work like a part of his arm; and with that famous Plumb invention which takes up any looseness in the handle, just by a turn of the screw.

Greater usefulness... longer life . . . less cost in the long run: Those are the reasons more and more manual training schools are adopted the Plumb Nail Hammer as standard in school shops. Specify HF81, 1-lb. head. Price $1.50. HF 82, 13. oz. head. Price $1.45.

FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

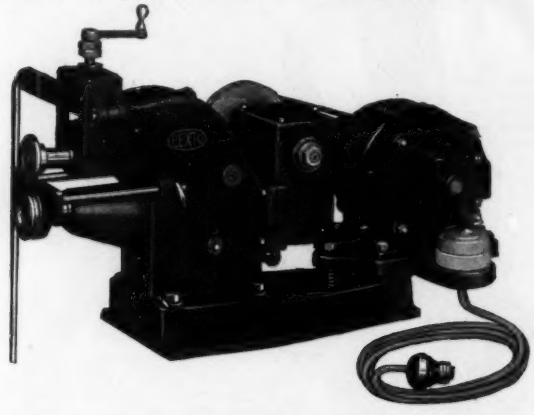
PLUMB
DOUBLE LIFE
Hammers Hatchets
Files Sledges Axes

School Shop Equipment News

For the Supervisor and Teacher who desires to keep abreast with news of new Machinery, Tools, Supplies, etc.

NEW ELECTRIC ROTARY MACHINE

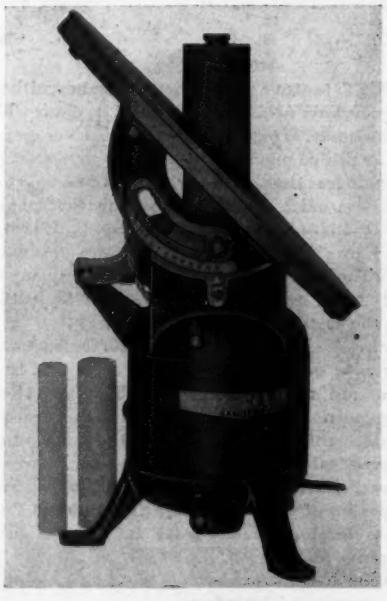
The Peck, Stow & Wilcox Company, of Southington, Conn., has announced its No. 623 Electric Rotary Machine for burring, turning, wiring, crimping, slitting, and beading in sheet metal. The machine is hand or foot operated, has both forward and reverse drive, provides three speeds, and is furnished complete with motor and floor pedestal.



Instructors in the sheet-metal shop will find this machine economical in operation and capable of quicker and easier work. Complete information will be sent to any instructor upon request.

NEW PORTER-CABLE OSCILLATING-SPINDLE SANDER

The Porter-Cable Company, of Syracuse, N. Y., has announced its new Type O–4 bench oscillating-spindle sander, for use in sanding operations in patternmaking and woodworking shops. It is especially suitable for all kinds of



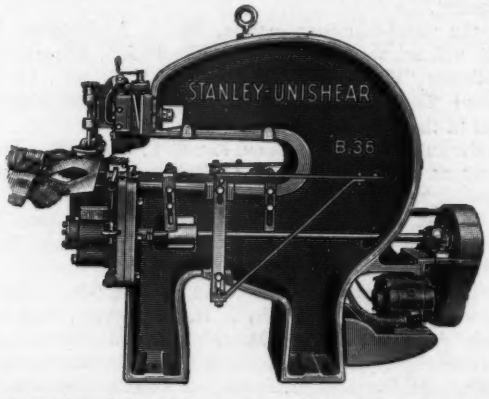
curved, irregular, and angular internal work on wood or metal in connection with the construction of furniture and novelties. The sander is useful on small core-box patterns, since it does away with much hand gouging, and it simplifies cam pattern and gear cover work.

A great advantage is the saving in time which this sander effects in making patterns, where straight lines on irregular work are required. It insures absolutely straight lines, with the proper draft. The sander contains some improvements in the form of an especially built motor of the repulsion-induction type, which can be operated on either 110 or 220 voltage, a longer motor shaft extending through the spindle, and a special steel sliding sleeve, which fits the spindle and eliminates small keys and keyway. The table is supported by a segment marked by degrees, which offers a perfect center, allows the table to be tiled 45 deg. down, and insures accurate drafts or angles. The spindle which oscillates 90 times per minute, has a ½ in. travel, and revolves at the same speed as the motor. The entire machine is of ball-bearing construction.

School-shop instructors who are interested in the new sander may obtain complete information by addressing the Porter-Cable Company at Syracuse, N. Y.

STANLEY UNISHEAR FOR SHEET-METAL WORK

The Stanley Electric Tool Company, of New Britain, Connecticut, has announced its Type B Stanley Unishear for sheet-metal work. The Type B Unishear has a cutting capacity up to ¼-in. boiler plate, cut up to 18 U.S. gauge hot-rolled steel, is capable of maintaining a speed of 10 ft. per minute,



and is equipped for either motor or belt drive. It cuts any desired curve, or circle, with a minimum radius of 6 in. on ¼-in. material, or even less than 3-in. radius on lighter material. It is useful for cutting or trimming the edges of flat stock to less than the thickness of the sheet.

The Stanley Company has prepared a booklet which will be sent to any school-shop instructor who asks for it.

NEW DIXON CATALOG

The Joseph Dixon Crucible Company, of Jersey City, New Jersey, has issued its 1930–31 catalog of school pencils for writing and drawing.

The catalog offers comprehensive information about the latest developments in pencils, crayons, erasers, and penholders for school and college use. Special attention is given to pencils for school drawing purposes, scientific drawing, mechanical and architectural drawing, commercial art and lettering, engineering drawing, and commercial drafting and design. It also lists a complete line of the best colored pencils, crayons for drawing, pencil erasers, beginners' pencils, high-school pencils, and penholders.

A copy of the catalog will be sent to any school official, or instructor, upon request.

(Continued on Page 33a)

AN AMAZING MACHINE
that slashes production costs ▲ ▲ ▲ ▲ ▲

The Challenge Type-High Unit and Portable Router

Now—you can have a router, router vise, and type-high machine all in one handy, compact, outfit that handles a wide range of work quickly, effectively and economically. With it you can plane and level wood-mounted or solid metal cuts to type-high, and do the finest kind of routing jobs.

Here's the outfit as a complete unit for routing or planing cuts. The router can be removed and used on forms locked up on the press bed.

View above shows unit with router removed. Slide can be adapted to type-high or 11-pt.

Put the Challenge Type-High Unit anywhere—plug into an ordinary light socket—and it's ready for action. It's a real time and labor-saver—a profitable investment for any big or little shop. See your dealer and write for new data sheet.

The Challenge Machinery Co.

Chicago 17-19 E. Austin Ave. **Grand Haven, Michigan** **New York** 200 Hudson Street

(Continued from Page 30a)

FOLEY IMPROVED AUTOMATIC SAW FILER

The Foley Manufacturing Company, of Minneapolis, Minn., has placed on the market its Model F–24 automatic saw filer, the result of a number of years of research, which is an improvement over the former Model F–5.

The Model F–24 has been designed to insure work of the greatest precision and longer life of the machine, to offer greater strength and rigidity, and to withstand the severest use. It is the only machine with all the bearing surfaces above the level of the file so that no metal particles may fall into them.

The machine is equipped with a 24-in. vise, permitting the sawing of circular saws up to 24 in. in diameter, band saws from ⅜ to 4½ in. wide, and all types of saws. Simple take-up adjustments for wear insure permanent accuracy in filing. An electric light attached to a ball swivel joint, throws light on the saw from either side of the filing arm and from any angle, and a patented filing device keeps all the saw teeth of the same size, height, and spacing. The device insures a saw which cuts smoothly, rapidly, uniformly, and which remains sharp longer because every tooth is the same height.

Complete information and prices concerning the Foley saw filer will be sent to any school-shop instructor upon request.

DAMAGE BY FIRE DOES NOT DELAY BUSINESS

The fire damage recently suffered by the Balsa Wood Co., Inc., of Brooklyn, New York, was fortunately confined to only one small warehouse of this company. Complete stocks of all sizes of Lata Balsa Wood are available.

PORTER-CABLE COMPANY COMBINES WITH HUTCHINSON COMPANY

The Porter-Cable Machine Company, of Syracuse, New York, and the Hutchinson Manufacturing Company, of Norristown, Pa., announce a combination for a more efficient marketing of their woodworking machines. The new company will be known as the Porter-Cable-Hutchinson Corporation with general sales offices at Syracuse, New York. The Porter-Cable Machine Company will continue to manufacture machine tools under the old name.

Sales agencies will be consolidated in all the principal cities of the United States and Canada.

NEW STANLEY UNBREAKABLE PLANE HANDLES

The Stanley Rule and Level Company, of New Britain, Conn., has announced an unbreakable plane handle of Aluminum, which is expected to solve the problem where such a handle is desirable.

(Continued on Page 34a)

Kewaunee

Art and Mechanical Drawing Room Furniture Gives All-Day Service

In selecting furniture for the Art and Mechanical Drawing Rooms, choose equipment that can be used every period of the day. In the Kewaunee Line are mechanical drawing and art tables that will accommodate from three to eight classes a day and that furnish individual instrument drawers for each student, as well as storage for drawing boards. All Kewaunee tables are very substantially built and do not get loose and wobbly with use.

Write for the Kewaunee Blue Book. It pictures and gives details on the largest variety of student art and mechanical drawing tables ever cataloged. It pictures instructors' desks, storage cabinets, blue print files, model stands and other modern equipment for the up-to-date school.

The Kewaunee Book is yours for the asking. Write for it on the letterhead of your institution.

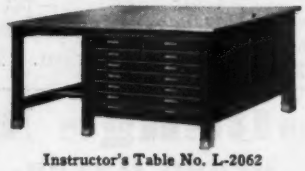
Kewaunee Mfg. Co.
LABORATORY FURNITURE EXPERTS
C. G. Campbell, Pres. and Gen. Mgr.
245 LINCOLN ST. KEWAUNEE, WIS.
Designers and Manufacturers of Art and Mechanical Drawing Room Furniture for Schools and Colleges
Factories at Kewaunee, Wis., and Adrian, Mich.

Drawing Table No. L-2028

Blueprint File No. L-2068

Art Table No. L-2077

Drawing Table No. L-2044


Instructor's Table No. L-2062

(Continued from Page 33a)

The aluminum handle, which is unbreakable, light in weight, and reasonable in price, is supplied only as a replacement part, and is not regularly furnished with the planes.

Complete information and prices may be obtained by any shop instructor upon request.

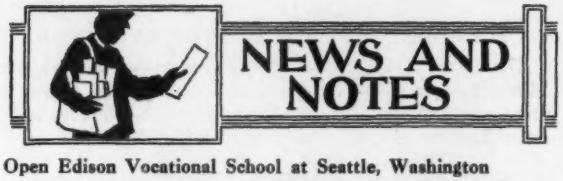
AN ELECTRIC TOOL MARKER

The Luma Electric Equipment Company, of Toledo, Ohio, is announcing an electric tool marker which will be of special interest to shop teachers.

With this electric etching pencil, etching may be done as fast as one can write on hardened steel surfaces, as well as on other metallic parts of tools. It also demagnetizes while it etches.

The entire instrument weighs about 15 lb. and may be attached to any a.c. light socket.

Information about this handy tool marker will be sent to any school-shop instructor who asks for it.



Open Edison Vocational School at Seattle, Washington

The Edison Vocational School at Seattle, Wash., was opened on September 2, with 24 teachers on the staff. The three-story building provides space for classes in power sewing, tailoring, beauty-parlor work, automobile mechanics, electricity, and drafting. It is planned to add further courses for journeyman and apprentice plumbers, paperhangers, painters, plasterers, and carpenters during the dull season of the building trades. Careful attention is given to the needs of the industry or occupational group, and individuals are especially selected for entrance into the courses. The new vocational courses offer opportunity to part-time students to obtain more definite trade preparation in connection with their continuation-school work.

New Vocational High School at Williamsport, Pa.

Plans have been completed for the vocational high school, to be erected at Williamsport, Pennsylvania. Mr. W. D. Shollenberger, of Williamsport, is the architect.

Building Class to Erect House at Baker, Oregon

The building-trades class at Baker, Oregon, has undertaken the erection of a home in connection with the vocational course. The course, which is conducted under the auspices of the Smith-Hughes Law, provides full and part-time instruction for those desiring to learn the building trades. The classes have completed a number of projects in house construction and repairwork on buildings.

(Continued on Page 36a)

MARK YOUR TOOLS

—the Luma way—

3 tools in one

An electric etching pencil
A demagnetizer
An annealing point

View of the Luma marking and demagnetizing in the same operation.

Up-to-date shop practice demands that all tools be carefully marked for identification. Proper marking of tools insures quick and accurate selection for a job—prevents costly mistakes—lessens the liability of loss through pilfering.

The LUMA combines in one compact, handy, portable production tool, weighing less than 20 lbs., an electric pencil for marking hardened and ground steel, a thorough demagnetizer, and a carbon point for light annealing and soldering.

A recent editorial in Industrial Arts and Vocational Education shows a very decided trend toward the thorough marking of tools in the school. An excerpt from the editorial is as follows: "The marking may be done in various ways, such as stamping, etching, printing, notching, etc. All of these methods are used, but not every teacher is equipped to do the work so that it does not look more like a disfigurement rather than as a mark of ownership."

The Luma will solve this problem easily and economically. Let us send you a Luma on 5-day free trial.

Luma ELECTRIC EQUIPMENT CO. TOLEDO, OHIO

Electric Equipment Co.

Toledo, Ohio, U.S.A.

✓ CHECK UP ON YOUR EQUIPMENT NEEDS!

How about your vocational equipment—is it in readiness to stand the gaff for the new year ahead—have you sufficient equipment to accommodate the students?

Whether you need Manual Training Benches, Drawing Tables, Storage Cases, Instructors' Tables, or any other specialized Vocational Furniture — you can get prompt shipment from SHELDON.

Check up today, and you may save much expense a little later. Take advantage of SHELDON'S complete facilities to serve you to your entire satisfaction — speedily.

E. H. SHELDON & COMPANY, Muskegon, Michigan

Specialists in Vocational Training

(Continued from Page 34a)

Simonds Prize Winners Announced

In the eighth annual Simonds Economic Contest, which closed December 31, 1929, the judges have awarded the first prize of one thousand dollars to Walter E. Spahr of New York University. The second prize of five hundred dollars went to Ivan W. Elder, of the North Pacific Bank, Portland, Oregon. Honorable mention was awarded to Helene Elizabeth Ham, of New York City. The largest number of essays came from the United States, but excellent ones were received from a number of foreign countries. Dr. Davis R. Dewey, of the Massachusetts Institute of Technology, and John G. Thompson, of the Simonds Saw and Steel Company, were the judges in the contest.

Aeronautic Courses in High Schools

Provision of a technical ground-school course in aviation for students in the secondary schools of California, has been made by the California Curriculum Commission, according to a recent statement of State Supt. Vierling Kersey. The course has been arranged by a subcommittee of the California Advisory Committee, which made its recommendations to the curriculum commission.

Varieties and Uses of Philippine Mahogany

The shipments of Philippine lumber into the United States during the second quarter of the current year amounted to 7,500,000 board feet, according to a recent statement of the Philippine Mahogany Association, of New York City. The report lists nine different kinds of this lumber, including apitong, palosapia, lumbayao, dao, ipil, tindalo, acle, and the light red and dark red types. Of the total shipments, the dark- and light-red types constituted the larger amounts.

Vocational Work in Virginia

The state board of vocational education of Virginia has reported that $542,107 has been expended for vocational work in the state. The expenditure was for agricultural education, trade and industrial education, home-economics education, and teacher-training work.

Vocational Budget at Beloit, Wisconsin

The school budget of Beloit, Wis., for the school year 1930–31 totals $57,995, as compared with $58,178 last year. Of the total, $40,164 will be raised through local taxation, as compared with $40,455 for last year.

Exhibit Artwork in Baltimore

An exhibit of artwork, including drawing, design, and craftwork, was held on October 2, in the children's room of the Baltimore Museum of Art. The work represented the activities of pupils in all grades of the Baltimore schools, including elementary, junior high, and senior high schools.

Vocational Certificate Issued to Students

The vocational department at Jamestown, N. Y., has announced that a special vocational certificate will be issued to students completing the two-year course. The vocational course is intended for students who expect to enter employment upon completion of the work, but students may begin with the sophomore year of high school after completing one term of summer work.

Open Connelley Trade School at Pittsburgh, Pennsylvania

The new Clifford B. Connelley Trade School at Pittsburgh, Pa., erected at a cost of $2,000,000, offers practical instruction to the boy desiring to learn a trade. The building is six stories high and is divided into two units, one part housing the main building containing the gymnasium, administration offices, lecture rooms, and cafeteria, and the other providing space for the various shops and foundries. The building has accommodations for 1,600 boys and cost $1,500,000 for the building and $500,000 for equipment.